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TESTING
NVLAP LAB CODE: 100275-0

Title 47 Code of Federal Regulations Test Report

Regulation:

FCC CFR 47 Part 15 Subpart E, Section 15.407

Client:

Nokia Solutions and Networks Oy

Product Evaluated:

AirScale Micro RRH 2T Band 46 LAA UNII-2 (AZRB) 4 Carriers (DFS)

GPCL Report Number:

TR2019-0025 FCC2-15E DFS

GPCL Project Number:

2019-0025 & 2019-0082

Date Issued:

September 17, 2019

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Date	Revision	Section	Change
9/16/2019	0		Initial Release

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1 ATTESTATION OF TEST RESULTS

Equipment Under Test (EUT):	AirScale Micro RRH Band 46 LAA (AZRB)
FCC ID:	2AD8UAZRBRH1
Serial Number(s)	1M181319958 (AZRB), 1850010 (PAS2457-CC1 Ant)
Hardware Version:	474510A.101
Software Version:	FL18A
Frequency Band:	E-UTRAN Band 46: 5250-5350 MHz (UNII-2a); 5470-5725 MHz (UNII-2c)
Type of Equipment:	Intentional Transceiver
GPCL File Numbers:	2019-0025, 2019-0119, 2019-0082
Applicant & Manufacturer:	Nokia Solutions and Networks, OY 2000 W. Lucent Lane Naperville, IL 60563 USA
Model Name:	AZRB
Test Requirement(s):	47 CFR FCC Part 15 Subpart E, Section 15.407 (DFS)
Test Standards:	FCC KDB 905462 D02 v02, April 8, 2016
Operation Mode	Master Device
Date Tested	August 2019
Type of Application	C2PC
Test Laboratory	Nokia Global Product Compliance Laboratory 600-700 Mountain Avenue Murray Hill, New Jersey 07974-0636 USA FCC Registration No/Designation No: 896745/US5302
Test Engineers	S. Gordon and J. Yadav
Test Results: The AirScale Micro RRH Band 46 LAA (AZRB) with PAS2457-CC1 Antenna, as tested met the above listed requirements. Report copies and other information not contained in this report are held by either the product engineer or in an identified file at the Global Product Compliance Laboratory in New Providence, NJ.	

The above product has been evaluated and found to be in compliance with the Commission's Rules and Regulations set forth in the above standards.

FCC Section 2.911(e) Certification of Technical Test Data

The technical test data presented in this report are accurate.

2 SUMMARY OF THE TEST RESULTS

Applied Standards: 47 CFR FCC Part Subpart E Section 15.407 UNII-2 (DFS) KDB 905462 D02				
Section	**FCC Rules**	**Description of Tests**	**Test Condition**	**Results In Compliance**
5.3	15.407 (h)(2)	DFS Detection Threshold	Radiated	Yes
5.4.1	15.407 (h)(2)	U-NII Detection Bandwidth		Yes
5.4.2	15.407 (h)(2)(ii)	Channel Availability Check Time		Yes
5.4.3	15.407 (h)(2)(iii)	In Service Monitoring		Yes
		Channel Move Time		
		Channel Closing Time		
		Non-Occupancy Period		
5.4.4		Statistical Performance Check		Yes

3 GENERAL INFORMATION

3.1 Product Descriptions

Table 3.1.1 Product Specifications

Specification Items	Description
Product Type	LAA LTE RRH
Radio Type	Intentional Transceiver
Power Type	DC: -38V to -57V AC: 80V to 276V (via external AC/DC Converter)
FCC Rules	15.407
Operation Mode	Master Device, Point to Multipoint
Communication Mode	Framed Based System
Modulation	OFDM (QPSK, 16QAM, 64QAM, 256QAM)
Technology	LAA LTE-TDD
Frequency Range	5250-5350 MHz (UNII-2a); 5470-5725 MHz (UNII-2c) E-UTRAN Band 46
Carrier Operating Frequency	5260-5320 MHz (UNII-2a); 5500-5720 MHz (UNII-2c)
(Aggregated) Bandwidth(s)	20/40/60/80MHz
MIMO	2Tx, 2Rx
Max Rated Conducted RF Power at Antenna Port in UNII-2	PAS2457-CC1 Antenna: 1x20MHz: 15.4dBm per port and 18.4dBm total nx20MHz: 16.4dBm per port and 19.4dBm total
Max Rated EIRP Power in UNII-2	PAS2457-CC1 Antenna: 1x20MHz: 28.9dBm nx20MHz: 29.9dBm
Min Conducted RF Power at Antenna Port	PAS2457-CC1 Antenna: 9.2dBm (8.3mW) per port and 12.2dBm (16.6mW) total
Min EIRP Power in UNII-2	PAS2457-CC1 Antenna: 21.7dBm
Time required for Power-on cycle	The time required for the power-on cycle is 125.55 seconds.
TPC Function	Yes (Test Report: TR2019-0082 FCC RF Non-DFS)
Software Version (Master)	FL18A
Hardware Version (Master)	474510A.101
Antennas	Refer to Section 3.5.
Secuirty of Parameters of Radar Waveforms	The information regarding the parameters of the detected Radar Waveforms is not available to the end user per KDB 905462 D02 Section 8.

3.2 Accessories

A Nokia BBU, Airscale System Module indoor (ASMi), was used for all testing. ASMi consists of an ASIA system module circuit pack and an ABIA baseband sub-module circuit pack. The ASMi was connected to the AZRB through fiber connection. The above accessory device is unmodified and is commercially available per FCC requirement given in 2.1033(b)(8).

3.3 Antenna(s)

3.3.1 Description of Antennas

Currently, there are seven available antennas (#1-#7) of two types to be equipped for this low power Band 46 LAA RRH AZRB. The demonstration of meeting the FCC Section 15.203 and KDB 353028 D01 requirements on these antennas has been presented in previous filings, where it stated that unique (non-standard) antenna connectors were designed with the product and professional installation was used. There are provisions for special connectors to be used for any external antennas. AARC antenna which has the lowest antenna gain was evaluated for its DFS performance in previous filing (TR2018-0233 FCC DFS).

Table 3.3.1 UNII-2 Antenna Data from Manufacturers

Ant No	Model Name	Antenna Type/ Size (mm)	Frequency (MHz)	Tx/Rx Port	Max Gain (dBi)	
					Port 1	Port 2
1	AARC	Directional 295(L) × 270(W) × 30(D)	5150 ~ 5850	Tx/Rx 1/2	4.91	4.91
2	FA2RC	Directional 160(L) × 110(W) × 44(D)	5150 ~ 5850	Tx/Rx 1/2	6.0	6.0
3	VVSSP-360S-F	Omni-Directional 600(L) × 100(R)	5150 ~ 5925	Tx/Rx 1/2	5.1	5.1
4	GQ2410-06645	Omni-Directional 634(L) × 127.5(R)	5150 ~ 5925	Tx/Rx 1/2	5.9	5.9
5	2205	Directional 198(W) × 24.5(D) × 198(H)	5150 ~ 5925	Tx/Rx 1/2	9.5	9.5
6	GO4806-06664	Omni-Directional, 1219(L) × 52(D)	5150 ~ 5925	Tx/Rx 1/2	6.0	6.0
7	FA2RA	Omni-Directional , 235(L) × 51(D)	5150 ~ 5850	Tx/Rx 1/2	7.5	7.5
8	BA-AIO3O3T3T3VJX65F-06	Directional 608(L) × 350(W) × 138(D)	5150 ~ 5925	Tx/Rx 1/2	9.5	9.5
9	PAS2457-CC1	Directional 545(L) × 138(W) × 38(D)	5150 ~ 5925	Tx/Rx 1/2	10.5	10.5

Table 3.3.2 UNII-2 Antenna Tested for DFS

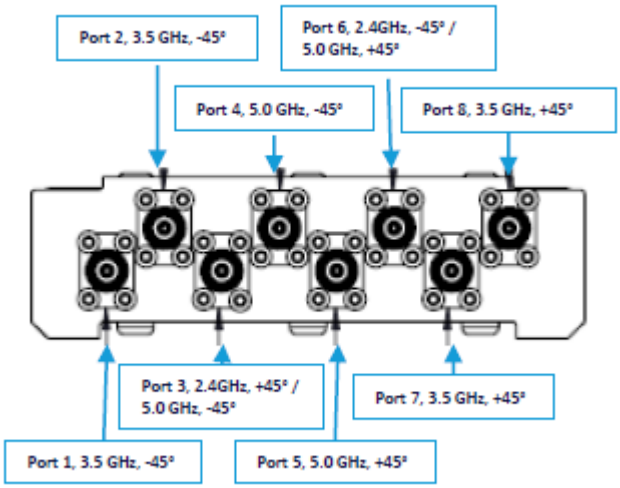
Antenna No	Model Name	Antenna Type	Frequency (MHz)	Gain (dBi)
1	AARC	Directional	5150 ~ 5925	4.43 ~ 4.91

BA-AIO3O3T3T3VJX65F-06 and PAS2457-CC1 antennas are two new directional antennas. BA-AIO3O3T3T3VJX65F-06 antenna is installed through 1:3 splitter and feedline (cable) where the pathloss is about 5.94-6.24dB. PAS2457-CC1 antenna is installed with a 33 ft cable from the AZRB to a splitter and then a 2 ft cable from the splitter to the antenna where the pathloss is about 7.54-7.84dB. The pathloss reduces the EUT's radar reception ability or gives the lower antenna effective gain. Therefore, the DFS compliance of the EUT with the directional antennas #9 PAS2457-CC1 needs to be evaluated. Also, the EUT is now capable of 4X20 MHz operation. Since this mode represents a wider bandwidth than previously qualified, the 4x20MHz mode of operation needs to be evaluated.

3.3.2 Antenna Configuration and Gain Verification

PAS2457-CC1 is an outdoor 8-port MIMO directional antenna operating in 3 bands, including 5150-5925MHz band. See the photos below.

The minimum antenna gain of PAS2457-CC1 measured by the antenna supplier is about 8.5 dBi in UNII band.



4 DFS REQUIREMENTS

4.1 Regulatory Requirements

The tests in this report were performed in accordance with FCC CFR 47 Part 15 Subpart E and FCC KDB 905462 D02 *Compliance Measurement Procedures for Unlicensed-National Information Infrastructure Devices Operating in the 5250-5350 MHz and 5470-5725 MHz Bands Incorporating Dynamic Frequency Selection*.

KDB 905462 D02 Section 7.8 stated that the EUT must pass all tests successfully. If the EUT fails any one of the tests it will count as a failure of compliance. To show compliance, all tests must be performed with waveforms randomly generated as specified with test results meeting the required percentage of successful detection criteria.

FCC Section 15.407(h)(2) specified the requirements for Dynamic Frequency Selection (DFS):

UNII devices operating in the 5.25–5.35 GHz and 5.47–5.725 GHz bands shall employ a DFS radar detection mechanism to detect the presence of radar systems and to avoid co-channel operation with radar systems. Operators shall only use equipment with a DFS mechanism that is turned on when operating in these bands. The device must sense for radar signals at 100 percent of its emission bandwidth. The minimum DFS detection threshold for devices with a maximum EIRP of 200 mW (23dBm) to 1 W (30dBm) is -64 dBm. For devices that operate with less than 200 mW (23dBm) EIRP the minimum detection threshold is -62 dBm. The detection threshold is the received power averaged over 1 µs referenced to a 0 dBi antenna. For the initial channel setting, the manufacturers shall be permitted to provide for either random channel selection or manual channel selection.

(i) Operational Modes. The DFS requirement applies to the following operational modes:

a. The requirement for channel availability check time applies in the master operational mode.
b. The requirement for channel move time applies in both the master and slave operational modes.

(ii) Channel Availability Check Time.

A U-NII device shall check if there is a radar system already operating on the channel before it can initiate a transmission on a channel and when it has to move to a new channel. The U-NII device may start using the channel if no radar signal with a power level greater than the interference threshold values is detected within 60 seconds.

(iii) Channel Move Time.

After a radar's presence is detected, all transmissions shall cease on the operating channel within 10 seconds. Transmissions during this period shall consist of normal traffic for a maximum of 200 ms after detection of the radar signal. In addition, intermittent management and control signals can be sent during the remaining time to facilitate vacating the operating channel.

(iv) Non-Occupancy Period.

A channel that has been flagged as containing a radar system, either by a channel availability check or in-service monitoring, is subject to a non-occupancy period of at least 30 minutes. The non-occupancy period starts at the time when the radar system is detected.

4.2 DFS Band Carrier Frequencies

Table 4.2.1 5GHz UNII-2 (5250-5350MHz, 5470-5725MHz) Frequency Channel Plan

Bands	Channel No	Freq (MHz)	Channel Bandwidth	Freq Bands
UNII-2a (B46b)	52	5260	20MHz	5250-5350
	56	5280		
	60	5300		
	64	5320		
UNII-2c (B46c)	100	5500	20MHz	5470-5725
	104	5520		
	108	5540		
	112	5560		
	116	5580		
	120	5600		
	124	5620		
	128	5640		
	132	5660		
	136	5680		
	140	5700		
	144	5720		
UNII-2a (B46b)	52, 56	5260, 5280	40MHz	5250-5350
	60, 64	5300, 5320		
UNII-2c (B46c)	100, 104	5500, 5520	40MHz	5470-5725
	108, 112	5540, 5560		
	116, 120	5580, 5600		
	124, 128	5620, 5640		
	132, 136	5660, 5680		
	140, 144	5700, 5720		

UNII-2a	52, 56, 60	5260, 5280, 5300	60MHz	5250-5350
UNII-2c (B46c)	100, 104, 108	5500, 5520, 5540	60MHz	5470-5725
	112, 116, 120	5560, 5580, 5600		
	124, 128, 132	5620, 5640, 5660		
	136, 140, 144	5680, 5700, 5720		
UNII-2a	52, 56, 60, 64	5260, 5280, 5300, 5320	80MHz	5250-5350
UNII-2c (B46c)	100, 104, 108, 112	5500, 5520, 5540, 5560	80MHz	5470-5725
	116, 120, 124, 128	5580, 5600, 5620, 5640		
	132, 136, 140, 144	5660, 5680, 5700, 5720		

4.3 DFS Technical Requirements

Table 4.3.1 Applicability DFS Requirements Prior to Use of a Channel (KDB 905462 D02 Table 1)

Requirement	Operational Mode		
	Master	Client (w/o Radar Detection)	Client (w Radar Detection)
Non-Occupancy Period	Yes	Not Required	Yes
DFS Detection Threshold	Yes	Not Required	Yes
Channel Availability Check Time	Yes	Not Required	Not Required
U-NII Detection Bandwidth	Yes	Not Required	Yes

Table 4.3.2 Applicability DFS Requirements during Normal Operation (KDB 905462 D02 Table 2)

Requirement	Operational Mode	
	Master or Client (w Radar Detection)	Client (w/o Radar Detection)
DFS Detection Threshold	Yes	Not Required
Channel Closing Transmission Time	Yes	Yes
Channel Move Time	Yes	Yes
U-NII Detection Bandwidth	Yes	Not

Additional requirements for devices with multiple bandwidth modes	Master or Client (w Radar Detection	Client (w/o Radar Detection)
U-NII Detection Bandwidth and Statistical Performance Check	All BW modes must be tested	Not Required
Channel Move Time and Channel Closing Transmission Time	Test using the widest BW mode	Test using the widest BW mode available for the link
All other tests	Any single mode	Not Required
Note: Frequencies selected for statistical performance check (Section 7.8.4) should include several frequencies within the radar detection bandwidth and frequencies near the edge of the radar detection bandwidth. For 802.11 devices, it is suggested to select frequencies in each of the bonded 20MHz channels and the channel center frequency.		

Operational Behavior	
Master Devices	a) The *Master Device* will use DFS in order to detect *Radar Waveforms* with received signal strength above the *DFS Detection Threshold* in the 5250 - 5350 MHz and 5470 - 5725 MHz bands. DFS is not required in the 5150 - 5250 MHz or 5725 - 5825 MHz bands. b) Before initiating a network on a *Channel*, the *Master Device* will perform a C*hannel Availability Check* for a specified time duration (*Channel Availability Check Time*) to ensure that there is no radar system operating on the *Channel*, using DFS described under subsection a) above. c) The *Master Device* initiates a U-NII network by transmitting control signals that will enable other U-NII devices to *Associate* with the *Master Device*. d) During normal operation, the *Master Device* will monitor the *Channel (In-Service Monitoring)* to ensure that there is no radar system operating on the *Channel*, using DFS described under a).

	e) If the *Master Device* has detected a *Radar Waveform* during *In-Service Monitoring* as described under d), the *Operating Channel* of the U-NII network is no longer an *Available Channel*. The *Master Device* will instruct all associated *Client Device(s)* to stop transmitting on this *Channel* within the *Channel Move Time*. The transmissions during the *Channel Move Time* will be limited to the *Channel Closing Transmission Time*. f) Once the *Master Device* has detected a *Radar Waveform* it will not utilize the *Channel* for the duration of the *Non-Occupancy Period*. g) If the *Master Device* delegates the *In-Service Monitoring* to a *Client Device*, then the combination will be tested to the requirements described under d) through f) above.

Table 4.3.3 DFS Response Requirements for Mater & Client Devices with DFS (KDB 905462 D02 Table 4)

Parameter	Value
Non-Occupancy Period	Min 30 Minutes
Channel Availability Check Time	60 seconds
Channel Move Time	10 seconds (Note 1)
Channel Closing Transmission Time	200 ms + an aggregate of 60 ms over remaining 10s period (Notes 1&2)
U-NII Detection Bandwidth	Minimum 100% of the UNII 99% transmission power bandwidth (Note 3)

Note 1: *Channel Move Time* and the *Channel Closing Transmission Time* should be performed with Radar Type 0. The measurement timing begins at the end of the Radar Type 0 burst.
Note 2: The *Channel Closing Transmission Time* is comprised of 200 milliseconds starting at the beginning of the *Channel Move Time* plus any additional intermittent control signals required to facilitate a *Channel* move (an aggregate of 60 milliseconds) during the remainder of the 10 second period. The aggregate duration of control signals will not count quiet periods in between transmissions.
Note 3: During the *U-NII Detection Bandwidth* detection test, Radar Type 0 should be used. For each frequency step the minimum percentage of detection is 90 percent. Measurements are performed with no data traffic.

4.4 DFS Detection Thresholds

Table 4.4.1 DFS Detection Threshold for Master & Client Devices with Radar Detection (KDB 905462 D02 Table 3)

Maximum Transmit Power	Value (See Notes 1 and 2)
EIRP ≥ 200 mW (23dBm)	-64 dBm
EIRP < 200 mW (23dBm) & PSD < 10dBm/MHz	-62 dBm

Note 1: This is the power level at the input of the receiver averaged over 1 µs referenced to 0 dBi receive antenna.
Note 2: Throughout these test procedures an additional 1dB has been added to the amplitude of the test transmission waveforms to account for variations in measurement equipment. This will ensure that the test signal is at or above the detection threshold level to trigger a DFS response.
Note 3: During the *U-NII Detection Bandwidth* detection test, Radar Type 0 should be used. For each frequency step the minimum percentage of detection is 90 percent. Measurements are performed with no data traffic.

Interference Detection Threshold to be used is:

Interference Detection Threshold Used = -64 dBm + 1 dB = -63 dBm,

where the gain of receive antenna needs to be taken into account if not 0 dBi.

4.5 Radar Test Waveforms

KDB 905462 D02 Section 6 provides the parameters for 7 required test waveforms (see Tables below), minimum percentage of successful detections, and the minimum number of trials that must be used for determining DFS conformance. Step intervals of 0.1 microsecond for Pulse Width, 1 microsecond for PRI, 1 MHz for chirp width and 1 for the number of pulses will be utilized for the random determination of specific test waveforms.

4.5.1 Short Pulse Radar Test Waveforms

A minimum of 30 unique waveforms are required for each of the Short Pulse Radar Types 2 through 4. If more than 30 waveforms are used for Short Pulse Radar Types 2 through 4, then each additional waveform must also be unique and not repeated from the previous waveforms. If more than 30 waveforms are used for Short Pulse Radar Type 1, then each additional waveform is generated with Test B and must also be unique and not repeated from the previous waveforms in Tests A or B.

For example, if in Short Pulse Radar Type 1 Test B a PRI of 3066 μsec is selected, the number of pulses would be

$$Roundup\left\{\left(\frac{1}{360}\right)\cdot\left(\frac{19\cdot 10^6}{3066}\right)\right\} = Roundup\{17.2\} = 18.$$

Table 4.5.1 Short Pulse Radar Waveforms (KDB 905462 D02 Table 5)

Radar Type	Pulse Width (µsec)	PRI (µsec)	Number of Pulses	Minimum Percentage of Successful Detection	Minimum Number of Trials
0	1	1428	18	See Note 1	See Note 1
1	1	Test A: 15 unique PRI values randomly selected from the list of 23 PRI values in Table 5a	Roundup $\left\{\left(\frac{1}{360}\right)\cdot\left(\frac{19\cdot 10^6}{PRI_{\mu sec}}\right)\right\}$	60%	30
		Test B: 15 unique PRI values randomly selected within the range of 518-3066 µsec, with a minimum increment of 1 µsec, excluding PRI values selected in Test A			
2	1-5	150-230	23-29	60%	30
3	6-10	200-500	16-18	60%	30
4	11-20	200-500	12-16	60%	30
Aggregate (Radar Types 1-4)				80%	120
Note 1: Short Pulse Radar Type 0 should be used for the detection bandwidth test, channel move time, and channel closing time tests.					

Table 4.5.1a - Pulse Repetition Intervals Values for Test A (KDB 905462 D02 Table 5a)

Pulse Repetition Frequency Number	Pulse Repetition Frequency (Pulses Per Second)	Pulse Repetition Interval (Microseconds)
1	1930.5	518
2	1858.7	538
3	1792.1	558
4	1730.1	578
5	1672.2	598
6	1618.1	618
7	1567.4	638
8	1519.8	658
9	1474.9	678
10	1432.7	698
11	1392.8	718
12	1355	738
13	1319.3	758
14	1285.3	778
15	1253.1	798
16	1222.5	818
17	1193.3	838
18	1165.6	858
19	1139	878
20	1113.6	898
21	1089.3	918
22	1066.1	938
23	326.2	3066

The aggregate is the average of the percentage of successful detections of Short Pulse Radar Types 1-4. For example, the following table indicates how to compute the aggregate of percentage of successful detections.

Radar Type	Number of Trials	Number of Successful Detections	Minimum Percentage of Successful Detection
1	35	29	82.9%
2	30	18	60%
3	30	27	90%
4	50	44	88%
Aggregate (82.9% + 60% + 90% + 88%)/4 = 80.2%			

4.5.2 Long Pulse Radar Test Waveform

Table 4.5.2. Long Pulse Radar Test Waveform (KDB 905462 D02 Table 6)

Radar Type	Pulse Width (μs)	Chirp Width (MHz)	PRI (ms)	No. of Pulses per Burst	No. of Bursts	Minimum % of Successful Detections	Min No. of Trials
5	50-100	5-20	1-2	1-3	8-20	80%	30

*The parameters for this waveform are randomly chosen. Thirty unique waveforms are required for the Long Pulse Radar Type waveforms. If more than 30 waveforms are used, then each additional waveform must also be unique and not repeated from the previous waveforms.

Each waveform is defined as follows:

1) The transmission period for the Long Pulse Radar test signal is 12 seconds.
2) There are a total of 8 to 20 *Bursts* in the 12 second period, with the number of *Bursts* being randomly chosen. This number is *Burst Count*.
3) Each *Burst* consists of 1 to 3 pulses, with the number of pulses being randomly chosen. Each *Burst* within the 12 second sequence may have a different number of pulses.
4) The pulse width is between 50 and 100 microseconds, with the pulse width being randomly chosen. Each pulse within a *Burst* will have the same pulse width. Pulses in different *Bursts* may have different pulse widths.
5) Each pulse has a linear frequency modulated chirp between 5 and 20 MHz, with the chirp width being randomly chosen. Each pulse within a *transmission period* will have the same chirp width. The chirp is centered on the pulse. For example, with a radar frequency of 5300 MHz and a 20 MHz chirped signal, the chirp starts at 5290 MHz and ends at 5310 MHz.
6) If more than one pulse is present in a *Burst*, the time between the pulses will be between 1000 and 2000 microseconds, with the time being randomly chosen. If three pulses are present in a *Burst*, the random time interval between the first and second pulses is chosen independently of the random time interval between the second and third pulses.
7) The 12 second transmission period is divided into even intervals. The number of intervals is equal to *Burst Count*. Each interval is of length (12,000,000 / *Burst Count*) microseconds. Each interval contains one *Burst*. The start time for the *Burst*, relative to the beginning of the interval, is between 1 and [(12,000,000 / *Burst Count*) – (Total *Burst* Length) + (One Random PRI Interval)] microseconds, with the start time being randomly chosen. The step interval for the start time is 1 microsecond. The start time for each *Burst* is chosen randomly.

The Figure below provides a graphical representation of the Long Pulse Radar Test Waveform.

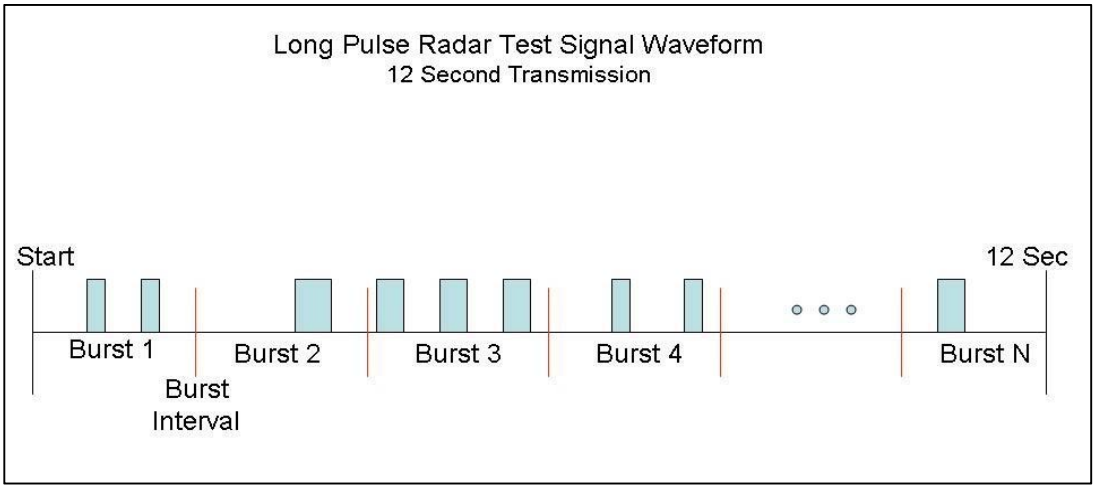


Figure 4.5.1: Graphical Representation of a Long Pulse Radar Type Waveform (KDB 905462 D02 Figure 1)

A representative example of a Long Pulse Radar Type waveform:

1) The total test waveform length is 12s.
2) Eight (8) *Bursts* are randomly generated for the *Burst Count*.
3) *Burst* 1 has 2 randomly generated pulses.
4) The pulse width (for both pulses) is randomly selected to be 75 ms.
5) The PRI is randomly selected to be at 1213 ms.
6) *Bursts* 2 through 8 are generated using steps 3 – 5.
7) Each *Burst* is contained in even intervals of 1,500,000 ms. The starting location for Pulse 1, *Burst* 1 is randomly generated (1 to 1,500,000 minus the total *Burst* 1 length + 1 random PRI interval) at the 325,001 ms step. *Bursts* 2 through 8 randomly fall in successive 1,500,000 ms intervals (i.e. *Burst* 2 falls in the 1,500,001 – 3,000,000 ms range).

4.5.3 Frequency Hopping Radar Test Waveform

Table 4.5.3. Frequency Hopping Radar Test Waveform (KDB 905462 D02 Table 7)

Radar Type	Pulse Width (µs)	PRI (µs)	Pulses per Hop	Hopping Rate (kHz)	Hopping Sequence Length	Minimum % of Successful Detections	Min No. of Trials
6	1	333	9	0.333	300	70%	30

For the Frequency Hopping Radar Type, the same Burst parameters are used for each waveform. The hopping sequence is different for each waveform and a 100-length segment is selected from the hopping sequence defined by the following algorithm:

The first frequency in a hopping sequence is selected randomly from the group of 475 integer frequencies from 5250 – 5724 MHz. Next, the frequency that was just chosen is removed from the group and a frequency is randomly selected from the remaining 474 frequencies in the group. This process continues until all 475 frequencies are chosen for the set. For selection of a random frequency, the frequencies remaining within the group are always treated as equally likely.

5 REQUIRED MEASUREMENTS AND RESULTS

5.1 Test Configurations and Setup

The radiated measurement method was used. The setup diagram(s) of the test and measurement system are given below.

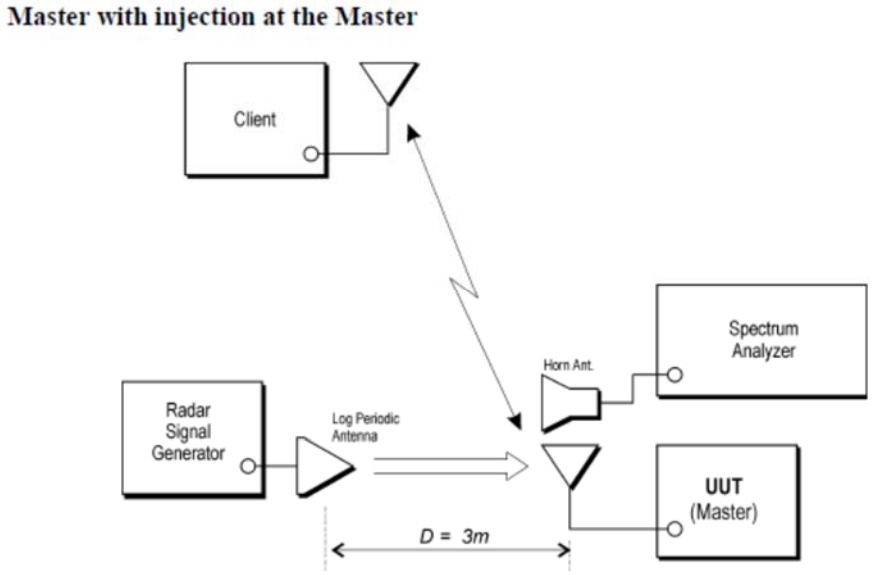


Figure 5.1.1 Setup Diagram of DFS Test with Radiated Method

5.2 Test Channels and Method

Per KDB 905462 D02 Section 7.8, one frequency needs to be chosen from the operating *Channels* of the EUT within the 5250-5350 MHz or 5470-5725 MHz bands. The radiated method was used.

Table 5.2.1 Frequency Channels and Radars Used for DFS Testing

Tests	Master (w Radar Detection)		Radar Type
	Channel/Freq (MHz)	Bandwidth	
Radar Waveform Calibration	100/5500	NA	Types 0- 6
U-NII Detection Bandwidth	100/5500	20	Type 0
	100, 104/5500, 5520	40	
	100, 104, 108 /5500, 5520, 5540	60	
	100, 104, 108, 112 /5500, 5520, 5540, 5560	80	
Channel Availability Check (CAC) Time	132/5680	20	Type 0
Channel Move Time and Channel Closing Transmission Time	52, 56, 60, 64/5260, 5280, 5300, 5320	80	Type 0

Non-Occupancy Period	132, 136, 140, 144 /5660, 5680, 5700, 5720	80	Type 0
Statistical Performance Check (For Radar Type 5, low and high channels were evaluated as well)	100/5500	20	Types 1- 6
	100, 104/5500, 5520	40	
	100, 104, 108 /5500, 5520, 5540	60	
	100, 104, 108, 112 /5500, 5520, 5540, 5560	80	

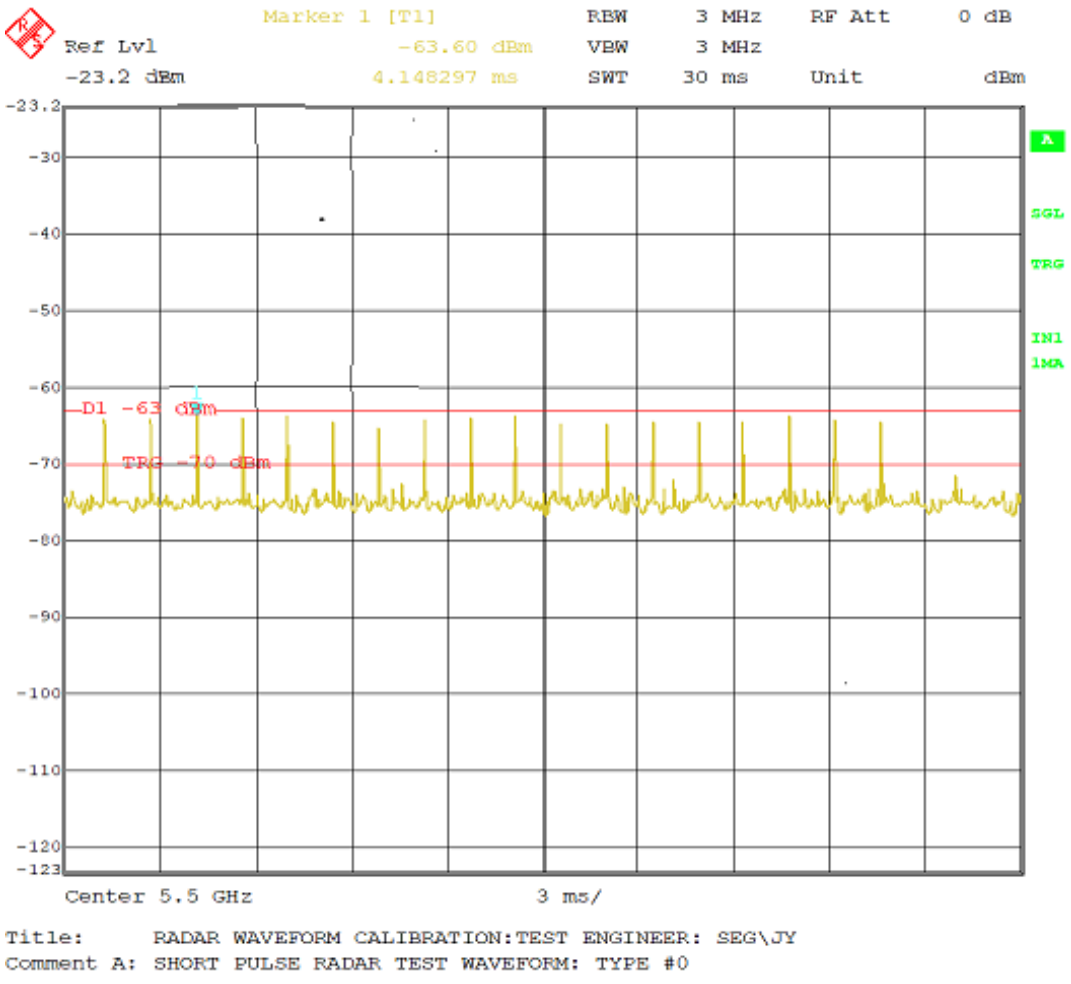
5.3 Radar Waveform Verification

The parameters for the required test waveforms are given in Section 4.5.

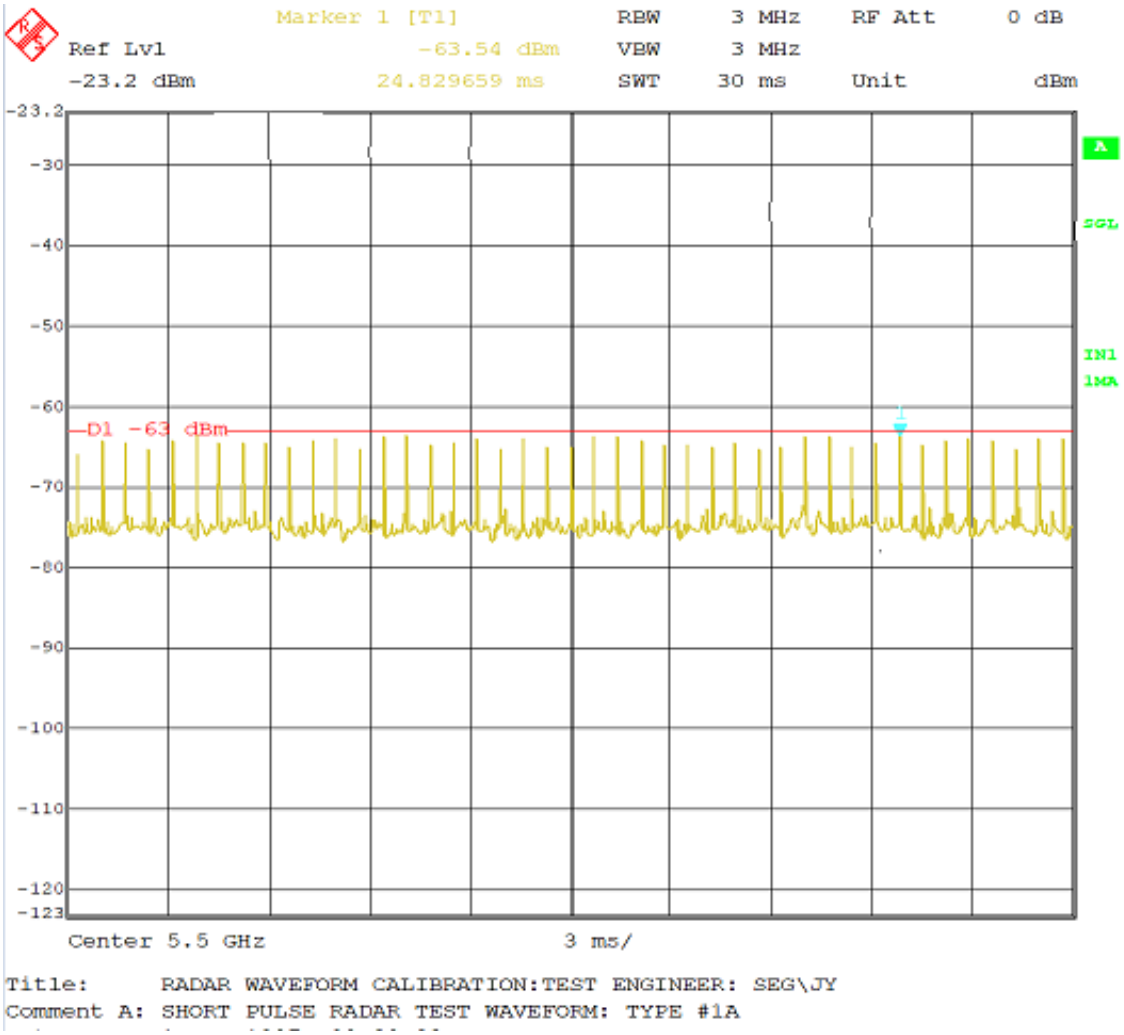
The radar waveforms Type 0-6 were verified by the radiated method with a spectrum analyzer with the 0 Hz span setting at the 5500MHz channel center frequency and were plotted below. The DFS Detection Threshold level -63dBm specified in Section 4.4 was verified as well and are shown in the plots where the receive antenna gain has been taken into consideration.

The block diagram of equipment setup is shown in Section 5.1, where the step intervals of 0.1 µs for pulse width, 1 µs for PRI (pulse repetition interval), 1MHz for chirp width and 1 for the number of pulses was utilized for the random determination for specific test waveform.

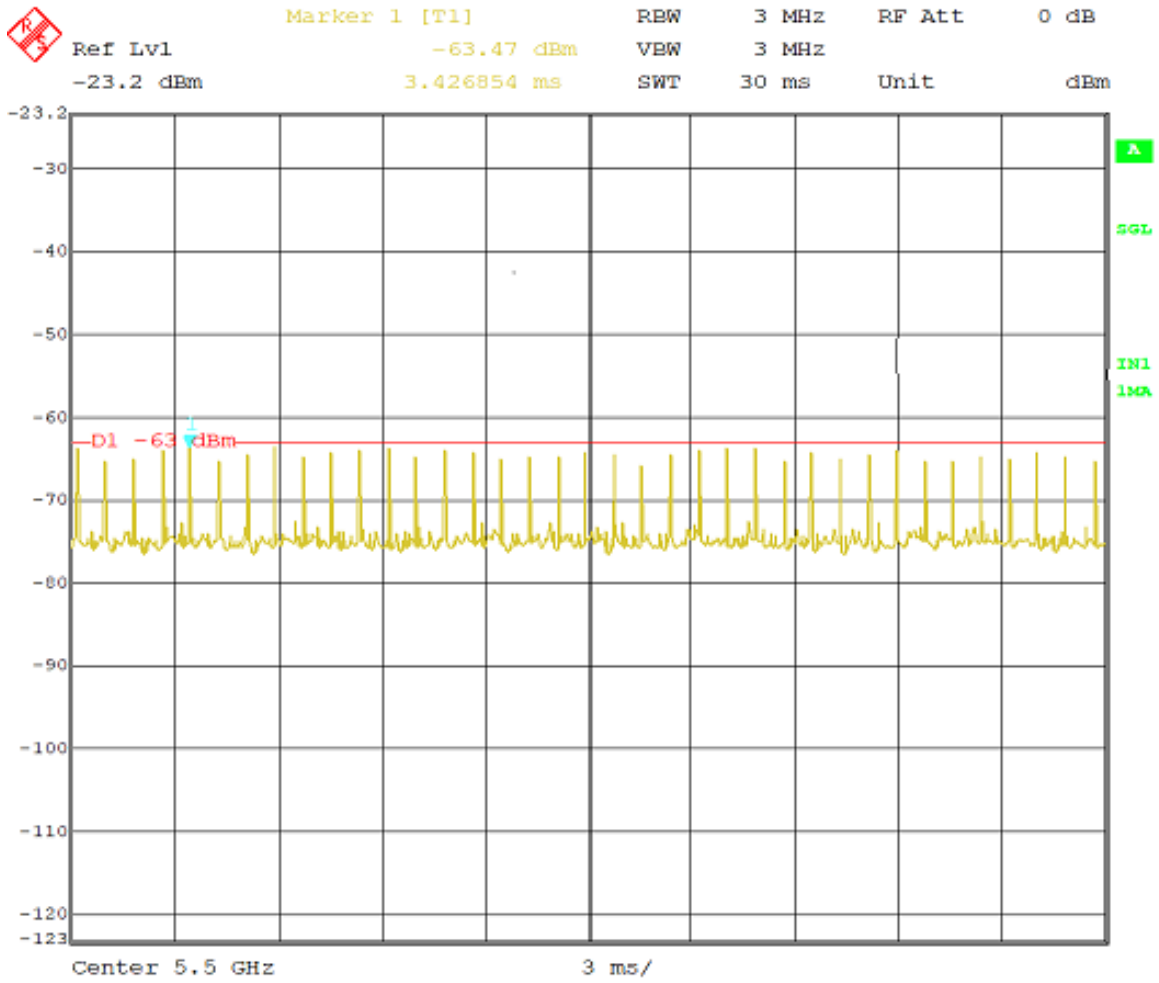
Short Pulse Radar Test Waveform Type 0



Short Pulse Radar Test Waveform Type 1A

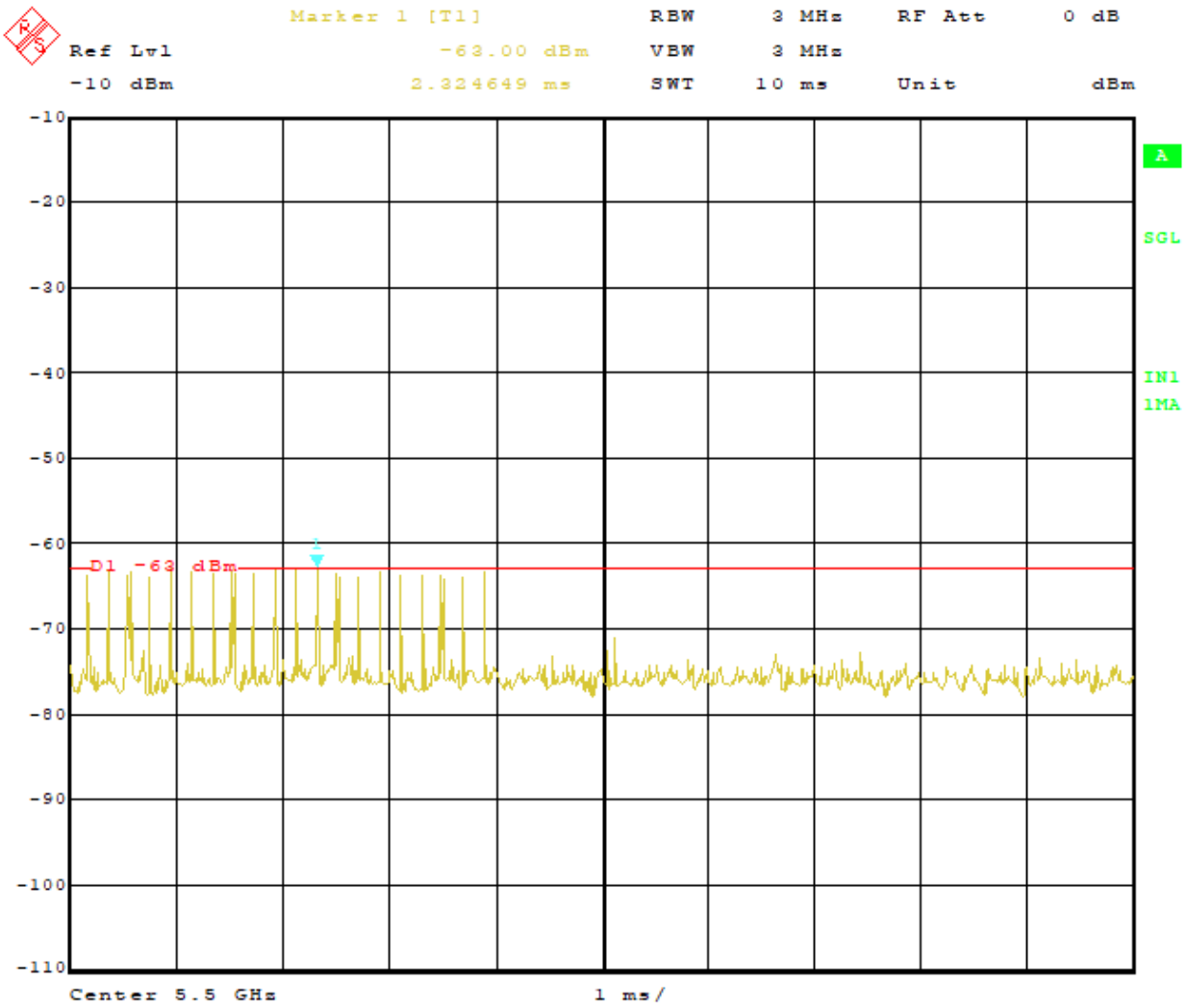


Short Pulse Radar Test Waveform Type 1B

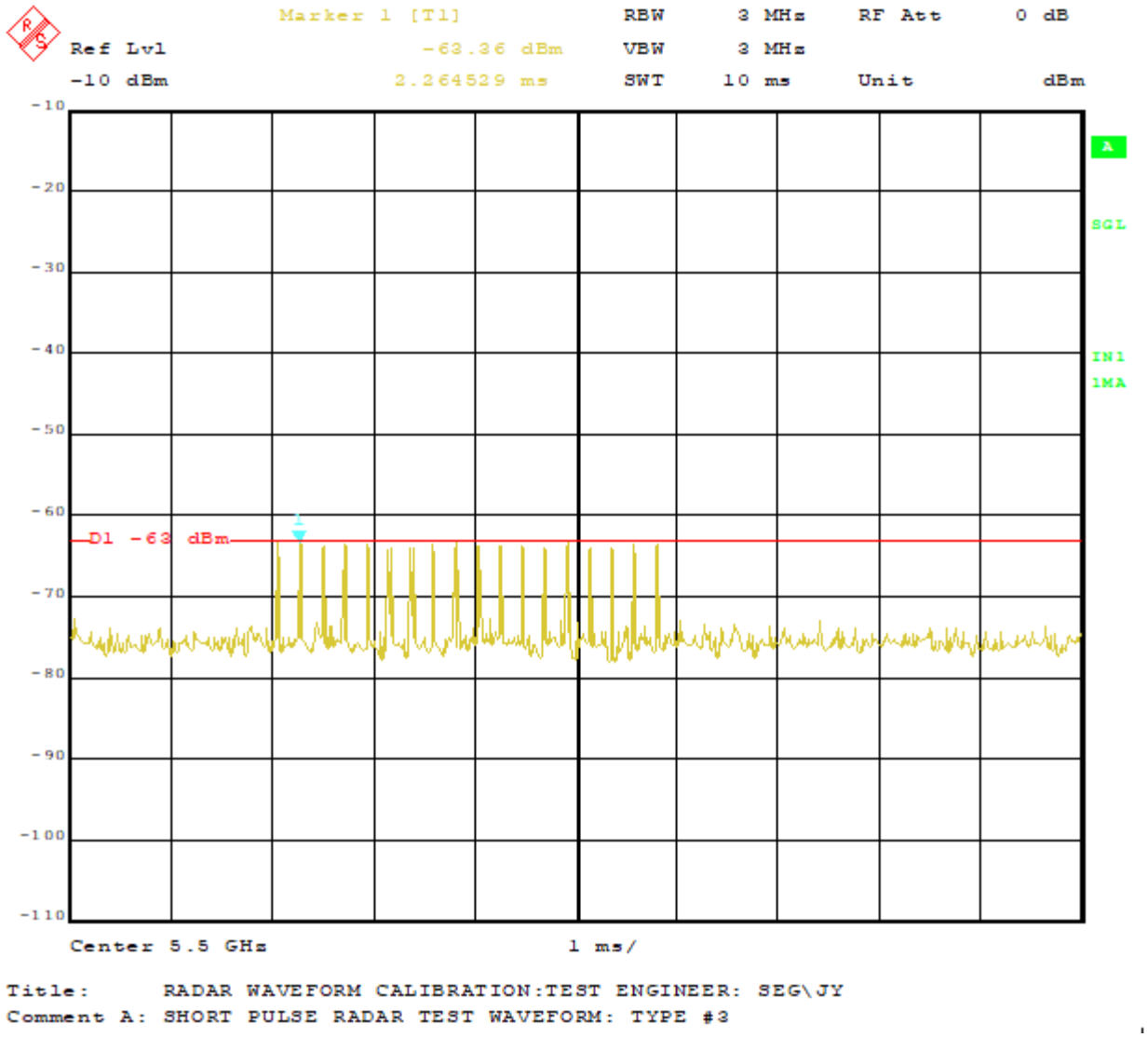


Title: RADAR WAVEFORM CALIBRATION:TEST ENGINEER: SEG\JY
Comment A: SHORT PULSE RADAR TEST WAVEFORM: TYPE #1B

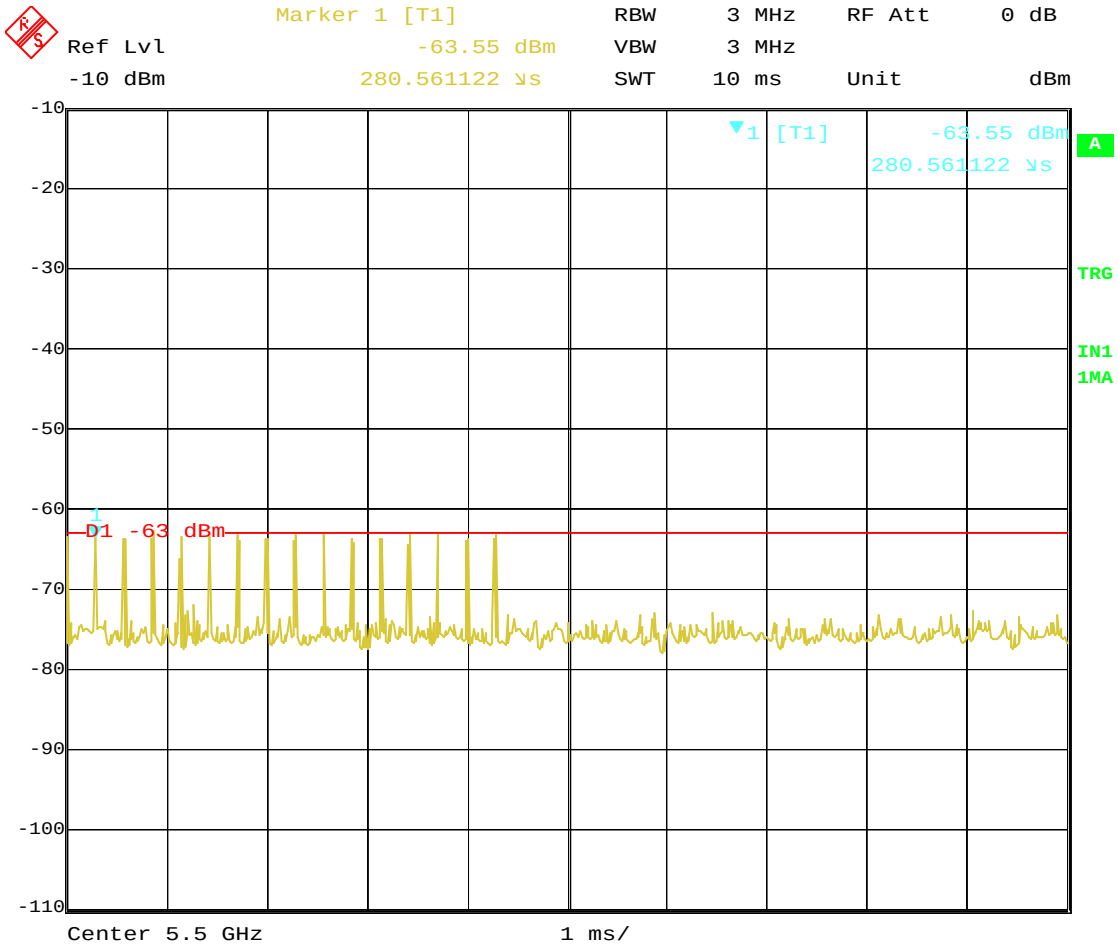
Short Pulse Radar Test Waveform Type 2



Short Pulse Radar Test Waveform Type 3

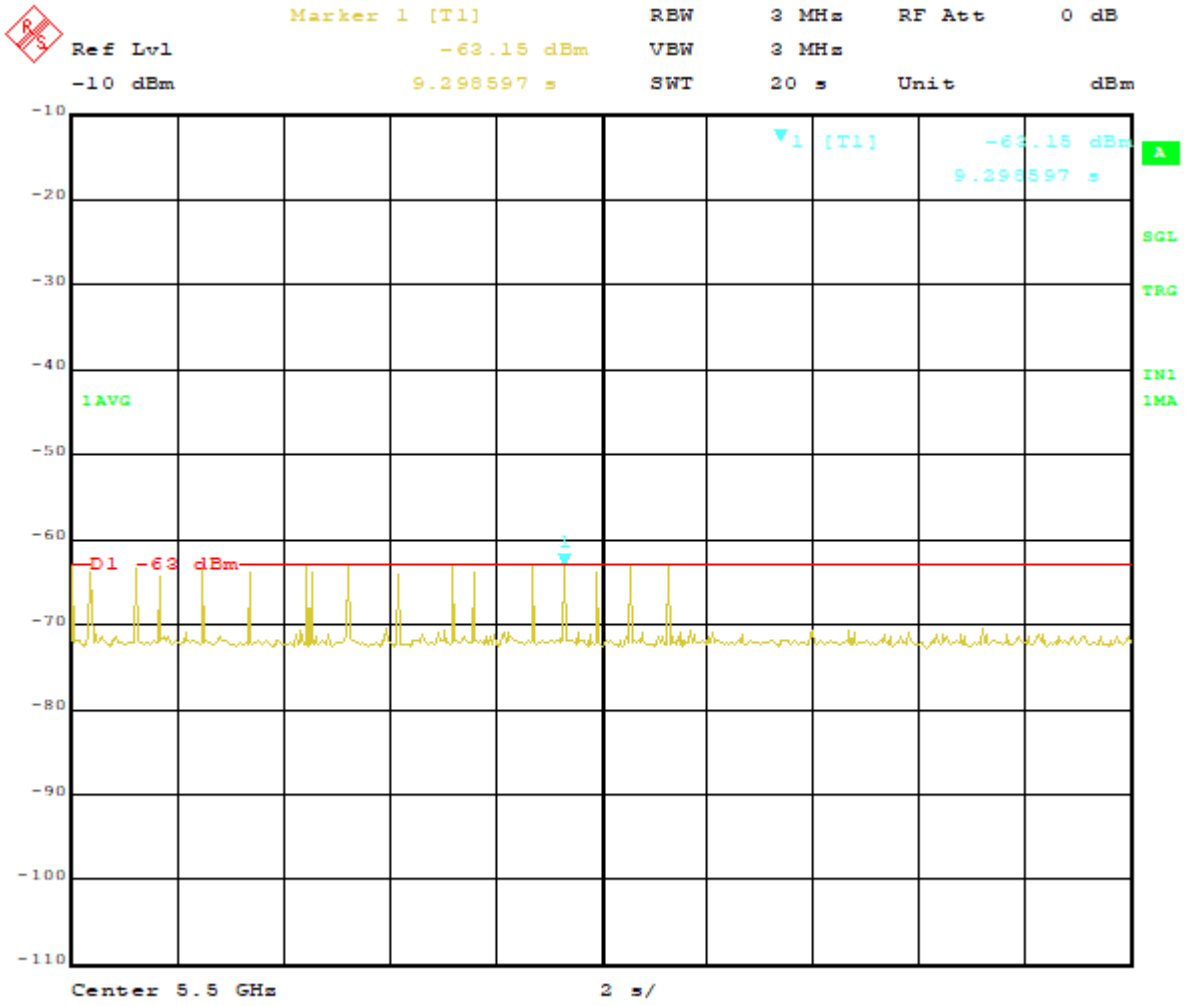


Short Pulse Radar Test Waveform Type 4



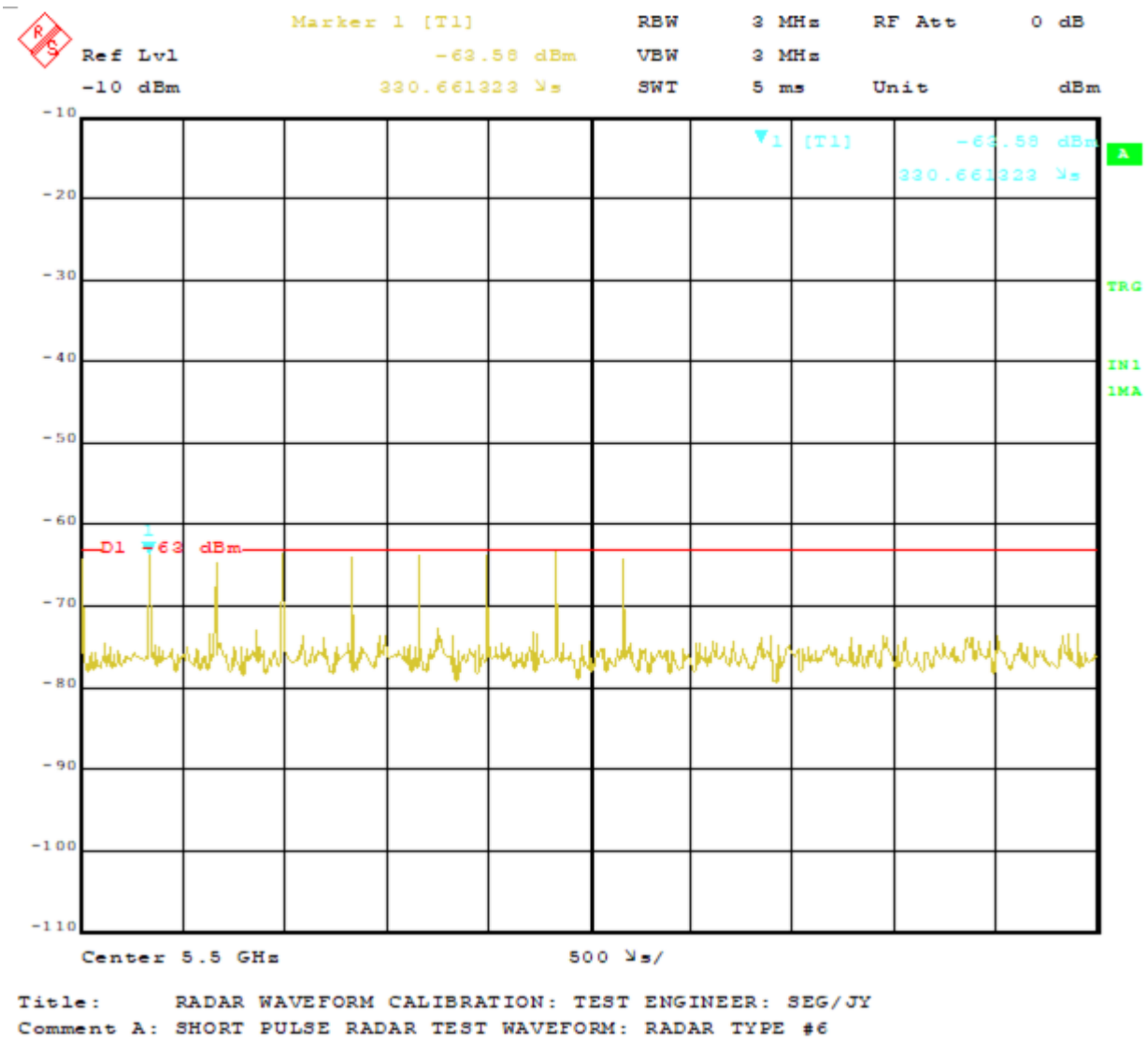
Title: RADAR WAVEFORM CALIBRATION: TEST ENGINEER: SEG/JY
Comment A: SHORT PULSE RADAR TEST WAVEFORM: RADAR TYPE #4
Date: 29.AUG.2019 18:51:52

Long Pulse Radar Test Waveform Type 5



Title: RADAR WAVEFORM CALIBRATION: TEST ENGINEER: SEG/JY
Comment A: SHORT PULSE RADAR TEST WAVEFORM: RADAR TYPE #5

Frequency Hopping Radar Test Waveform Type 6



5.4 DFS Conformance Evaluation

The EUT has four statuses: Power-up Mode, Normal Mode, Channel Availability Check status and Radar detection events. Their performance requirements are provided in Table 4.3.3.

5.4.1 U-NII Detection Bandwidth

The purpose of this test is to subject the EUT to a Type 0 FCC radar pulse while moving the frequency of the radar signal through the channel to characterize the range of frequencies over which the EUT can detect the radar pulse. This is essential to ensure that the EUT is capable of detecting *Radar Waveforms* across the same frequency spectrum that contains the significant energy from the system. This test is performed on a single channel. All channel bandwidths have been evaluated by using Short Pulse Radar Type 0 per KDB 905462 D02 Section 5.1 and 7.1.

The testing procedures and setup used per KDB 905462, Section 7.8.1 are given below:

- Measure the 99% BW of the operating channel.
- Adjust the equipment to produce a single *Burst* at the center frequency of the EUT *Operating Channel* at the specified *DFS Detection Threshold* level.
- Generate a single radar *Burst* and repeat for a minimum of 10 trials. The EUT must detect the *Radar Waveform* within the DFS band using the specified *U-NII Detection Bandwidth* criterion shown in Table 4.3.3 (90%). In cases where the channel bandwidth may exceed past the DFS band edge on specific channels (i.e., 802.11ac or wideband frame based systems), select a channel that has the entire emission bandwidth within the DFS band. If this is not possible, test the detection BW to the DFS band edge.
- Starting at the center frequency of the EUT operating *Channel*, increase the radar frequency in 5 MHz steps, repeating the above test sequence, until the detection rate falls below the *U-NII Detection Bandwidth* criterion specified in Table 4.3.3. Repeat this measurement in 1MHz steps at frequencies 5 MHz below where the detection rate begins to fall. Record the highest frequency (denote as F_H) at which detection is greater than or equal to the *U-NII Detection Bandwidth* criterion. Recording the detection rate at frequencies above F_H is not required to demonstrate compliance.
- Starting at the center frequency of the EUT operating *Channel*, decrease the radar frequency in 5 MHz steps, repeating the above test sequence, until the detection rate falls below the *U-NII Detection Bandwidth* criterion specified in Table 4.3.3 (90%). Repeat this measurement in 1MHz steps at frequencies 5 MHz above where the detection rate begins to fall. Record the lowest frequency (denote as F_L) at which detection is greater than or equal to the *U-NII Detection Bandwidth* criterion. Recording the detection rate at frequencies below F_L is not required to demonstrate compliance.
- *U-NII Detection Bandwidth* = $F_H - F_L$.
- In the case that the *U-NII Detection Bandwidth* is greater than or equal to the 99% power bandwidth for the measured F_H and F_L, the test can be truncated and the *U-NII Detection Bandwidth* can be reported as the measured F_H and F_L.

During the test, more than one detection could occur for each trial due to the fact that two sequential radar detection windows could pick up the same burst: one could detect the beginning of the burst and the other could detect the end of the same pulse. Therefore, multiple detections occurring during each trial are considered as one detection only.

Table 5.4.1.1 Measurement Set Up for U-NII Detection Bandwidth

Burst	Short Pulse Radar Waveform Type 0 and Repeat a min of 10 Trials
EUT	As a standalone Master or Client device with no associated Client or Master. No Traffic. Frame based systems will be set to a talk/listen ratio
Requirement	Minimum 100% of the UNII 99% transmission power bandwidth.
Criteria	For each frequency step the minimum percentage of detection is 90 percent.

The test results were summarized below.

Table 5.4.1.2 Maximum 99% Bandwidth Measured (TR2018-0233 and TR2018-0157)

Bands (GHz)	Bandwidth (MHz)	Max 99% BW (MHz)
UNII-2	1 x 20MHz	18.2
	2 x 20MHz	37.8
	3 x 20MHz	57.7
	4 x 20MHz	77.6

Table 5.4.1.3 U-NII Detection Bandwidth Test Data (20MHz)

Radar Freq (MHz)	Number of Trials	Number of Detected	Detection (%)	Mark
5489	10	0	0	
5490	10	10	100	F_L
5491	10	10	100	
5492	10	10	100	
5495	10	10	100	
5500	10	10	100	
5505	10	10	100	
5508	10	10	100	
5509	10	10	100	
5510	10	10	100	F_H
5511	10	10	0	
F_H - F_L (MHz) =				20

Table 5.4.1.4 U-NII Detection Bandwidth Test Data (40MHz)

Radar Freq (MHz)	Number of Trials	Number of Detected	Detection (%)	Mark
5489	10	0	0	
5490	10	10	100	F_L
5491	10	10	100	
5492	10	10	100	
5495	10	10	100	
5500	10	10	100	
5510	10	10	100	
5520	10	10	100	
5525	10	10	100	
5528	10	10	100	
5529	10	10	100	F_H

5530	10	3	30	
5531	10	0	0	
$F_H - F_L$ (MHz) =				39

Table 5.4.1.5 U-NII Detection Bandwidth Test Data (60MHz)

Radar Freq (MHz)	Number of Trials	Number of Detected	Detection (%)	Mark
5489	10	0	0	
5490	10	10	100	F_L
5491	10	10	100	
5492	10	10	100	
5493	10	10	100	
5495	10	10	100	
5500	10	10	100	
5510	10	10	100	
5520	10	10	100	
5530	10	10	100	
5540	10	10	100	
5545	10	10	100	
5548	10	10	100	F_H
5549	10	0	0	
5550	10	1	10	
$F_H - F_L$ (MHz) =				58

Table 5.4.1.6 U-NII Detection Bandwidth Test Data (80MHz)

Radar Freq (MHz)	Number of Trials	Number of Detected	Detection (%)	Mark
5489	10	0	0	
5490	10	10	100	F_L
5491	10	10	100	
5492	10	10	100	
5493	10	10	100	
5494	10	10	100	
5495	10	10	100	
5500	10	10	100	
5510	10	10	100	
5515	10	10	100	
5520	10	10	100	
5525	10	10	100	
5530	10	10	100	
5540	10	10	100	
5550	10	10	100	
5560	10	10	100	
5565	10	10	100	
5566	10	10	100	
5567	10	10	100	
5568	10	9	90	
5569	10	9	90	F_H

5570	10	1	10	
F_H - F_L (MHz) =				79

Table 5.4.1.5 Measurement Result for U-NII Detection Bandwidth

Channel Bandwidth	Waveform Name	Detection Bandwidth $F_H - F_L$	99% BW Measured	% of BW Detected	Min % of BW Required	Results
20MHz	Short Pulse Radar Type 0	20 MHz	18.2	100 %	100%	PASS
40MHz	Short Pulse Radar Type 0	39 MHz	37.8	100 %	100%	PASS
60MHz	Short Pulse Radar Type 0	58 MHz	57.7	100 %	100%	PASS
80MHz	Short Pulse Radar Type 0	79MHz	77.6	100%	100%	PASS

The *U-NII Detection Bandwidth* met the *U-NII Detection Bandwidth* requirement.

5.4.2 Channel Availability Check Time

The EUT shall perform a Channel Availability Check (CAC) to ensure that there is no radar operating on the channel:

- A U-NII device shall check if there is a radar system already operating on the channel before it can initiate a transmission on a channel and when it has to move to a new channel.
- The U-NII device may start using the channel if no radar signal with a power level greater than the minimum detection threshold is detected within 60 seconds.

This evaluation includes Initial Channel Availability Check and Radar Burst at both the Beginning and Ending of the Channel Availability Check Time. The requirements are given in Table below.

Table 5.4.2.1 Measurement Requirements for CAC

Timing of Radar Burst	Display on Control Computer	SA Display
No Radar Triggered	EUT marks Channel as active	Transmission begins on channel at least 1 min after completion of the initial power-up cycle
Within 0-6 Seconds Window (Beginning of CAC)	EUT indicates radar detected; EUT does not display any radar parameter values	No transmission on channel.
Within 54 to 60 Seconds Window (End of CAC)	EUT indicates radar detected; EUT does not display any radar parameter values	No transmission on channel.

The CAC test only needs to be performed for one channel bandwidth.

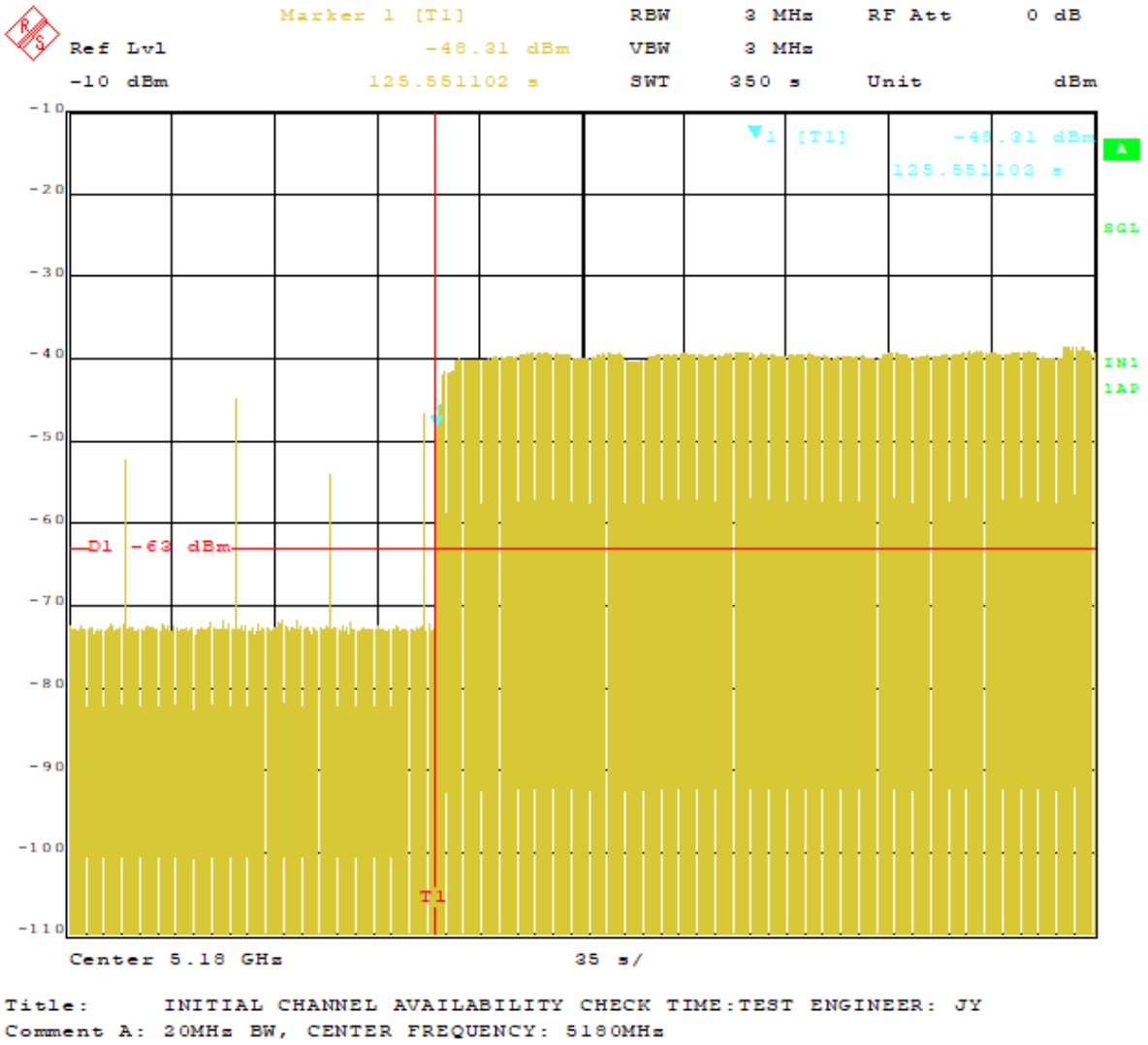
5.4.2.1 *Power-On Time*

The procedures used for measuring power-on time are as follows:

- Set the EUT at a *non-DFS* channel: Ch 36 at 5180 MHz,
- The spectrum analyzer is set to zero span mode with a 3 MHz RBW and 3 MHz VBW.
- Let the spectrum analyzer's sweep start at the same time when the EUT is rebooted. If not, record the time the SA is powered-on T_0.
- Mark the time T_1 on the plot as the time when the power-on cycle is completed.
- Record T_1 as the power-on cycle time of the EUT.

The measurement plot is shown below. The power-on time of the EUT measured T_1-T_0 is 125.55 seconds.

Power-On Cycle Length Measurement



5.4.2.2 Initial Channel Availability Check Time

This test ensures that the EUT does not emit beacon, control, or data signals on the test channel until the power-up sequence has been completed and the U-NII device checks for Radar Waveforms for one minute on the test channel. This test does not use any Radar Waveforms and only needs to be performed one time.

The test procedures used are given below:

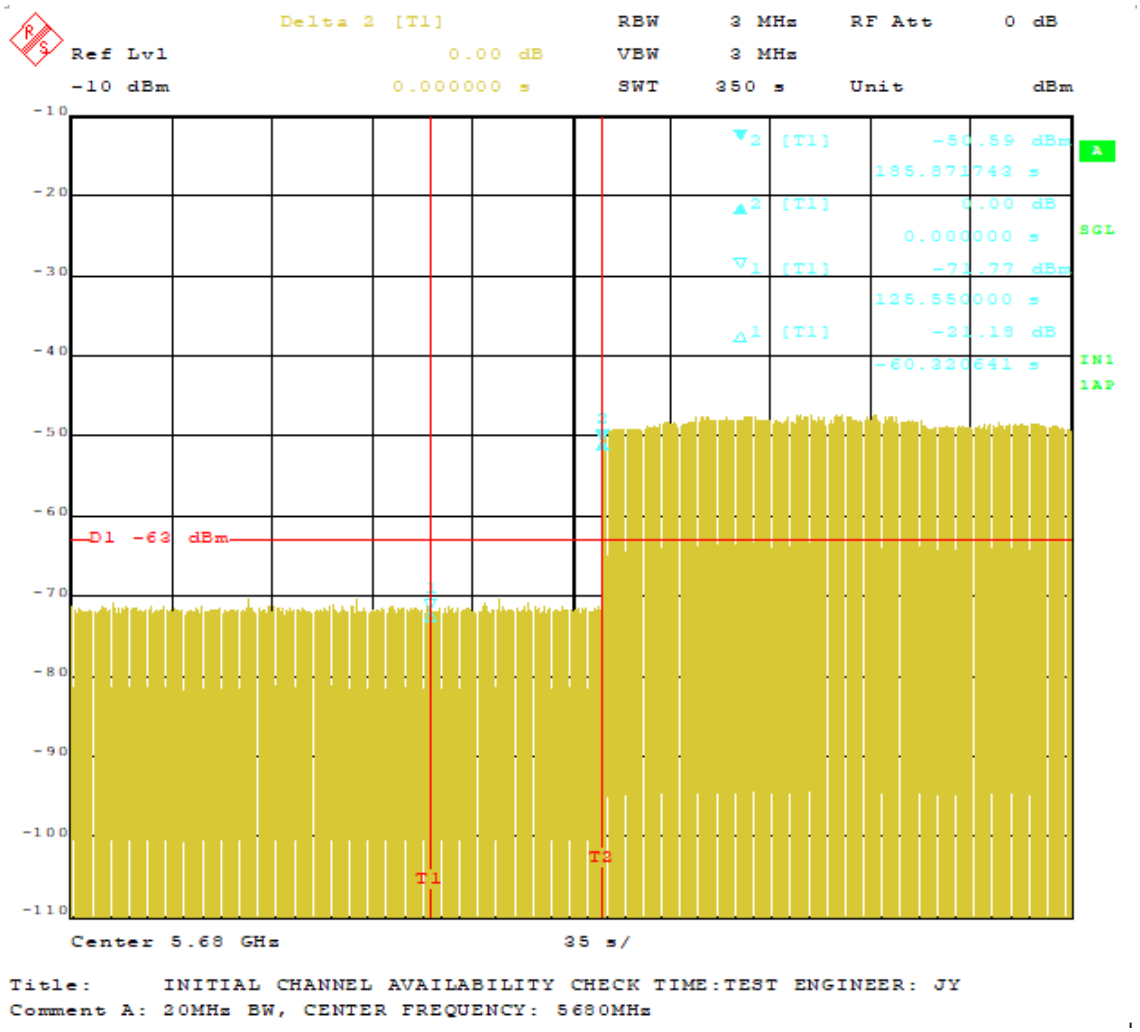
- The U-NII devices is powered on and be instructed to operate on an appropriate U-NII *DFS* channel.
- The spectrum analyzer is set to zero span mode with a 3 MHz RBW and 3 MHz VBW on the channel occupied by the radar (Ch_r).
- The spectrum analyzer's sweep is started at the same time power is applied to the U-NII device.

- Mark the time T_1 on the plot as the time when the power-on cycle is completed.
- Mark the time T_2 on the plot as the time when EUT starts to transmit.
- The EUT should not transmit any beacon or data transmissions until at least 1 minute after the completion of the power-on cycle, i.e, T_2-$T_1 \geq 60$ seconds.

Plot for Initial Channel Availability Check (20MHz)

Channel: Ch 136 @ 5680MHz:
T_1 = 125.55 seconds
T_2 = 185.87 seconds
$T_2 - T_1$ = 60.32seconds ≥ 60 seconds
The CAC time is 60.3 seconds

The EUT started to transmit the data more than 1 minute after the completion of the power-on cycle.



5.4.2.3 Radar Burst at the Beginning of the Channel Availability Check Time

The steps below give the procedure to verify successful radar detection on the test channel during a period equal to the Channel Availability Check Time and avoidance of operation on that channel when a radar burst at the beginning of the Channel Availability Check Time:

- Connect the Radar Waveform generator and the EUT together with the EUT power off.
- Set the power level of the radar test signal.
- The EUT is powered on at T_0 and completes its power-up sequence (T_{power_up}) at T_1.
- The Channel Availability Check Time commences on Ch_r at instant T_1 and will end no sooner than $T_1 + T_{ch\_avail\_check}$. $T_{ch\_avail\_check} \geq 60$ seconds.
- A single Burst of the Short Pulse Radar Type 0 will commence within a 6 second window starting at T_1.
- Visual indication or measured results on the EUT of successful detection of the radar Burst will be recorded and reported. Observation of Ch_r for EUT emissions will continue for 2.5 minutes after the radar Burst has been generated.
- Verify that during the 2.5minute (150 seconds) measurement window no EUT transmissions occurred on Ch_r. The CAC results will be recorded.

Plot of Radar Burst at the Beginning of the Channel Availability Check Time

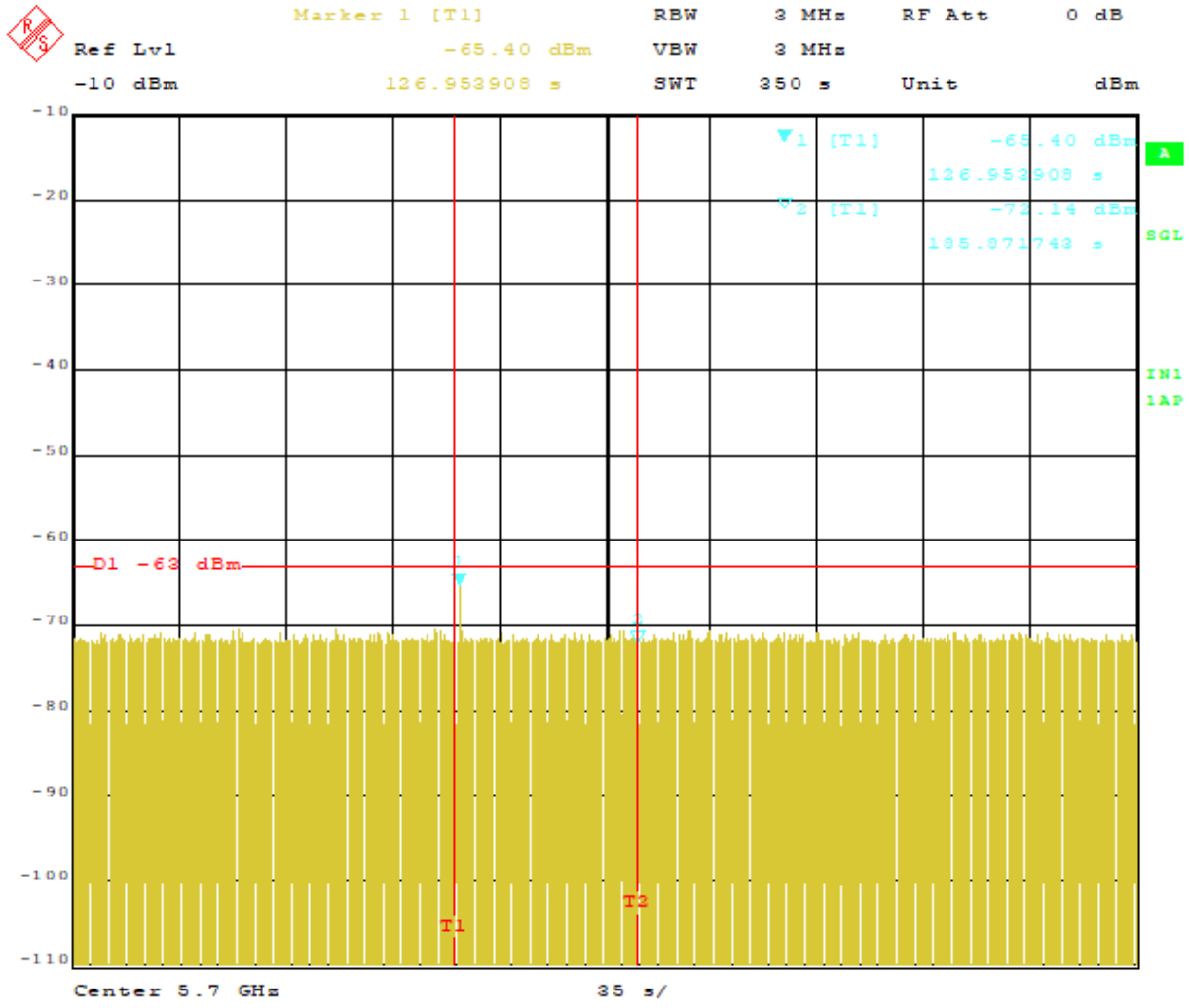
Channel: Ch 136 @ 5680MHz:

T_1 = 125.55 seconds (power on)

T_2 = 185.87 seconds (CAC ends)

Marker 1 = 126.95 seconds (radar)

The plot below shows that the radar burst was commenced at 126.95 seconds which is 1.4 seconds after the power-on cycle or CAC starting time. Observation of Ch_r for EUT emissions continued for more than 150 seconds after the radar Burst has been generated. It has been verified that during the 2.5 minutes (150 seconds) measurement window no EUT transmissions occurred on Ch_r.


Marker 1 [T1]
RBW 3 MHz
RF Att 0 dB
Ref Lvl
-65.40 dBm
VBW 3 MHz
-10 dBm
126.953908 s
SWT 350 s
Unit dBm
1 [T1] -65.40 dBm
126.953908 s
2 [T1] -72.14 dBm
185.871743 s
A
SGL
IN1
1AP
D1 -63 dBm
T1
T2
Center 5.7 GHz
35 s/
Title: RADAR BURST AT THE BEGINNING OF CAC TIME:TEST ENGINEER: JY
Comment A: 20MHz BW, CENTER FREQUENCY: 5700MHz

5.4.2.4 Radar Burst at the End of the Channel Availability Check Time

The steps below define the procedure to verify successful radar detection on the test channel during a period equal to the Channel Availability Check Time and avoidance of operation on that channel when a radar burst at the end of the Channel Availability Check Time:

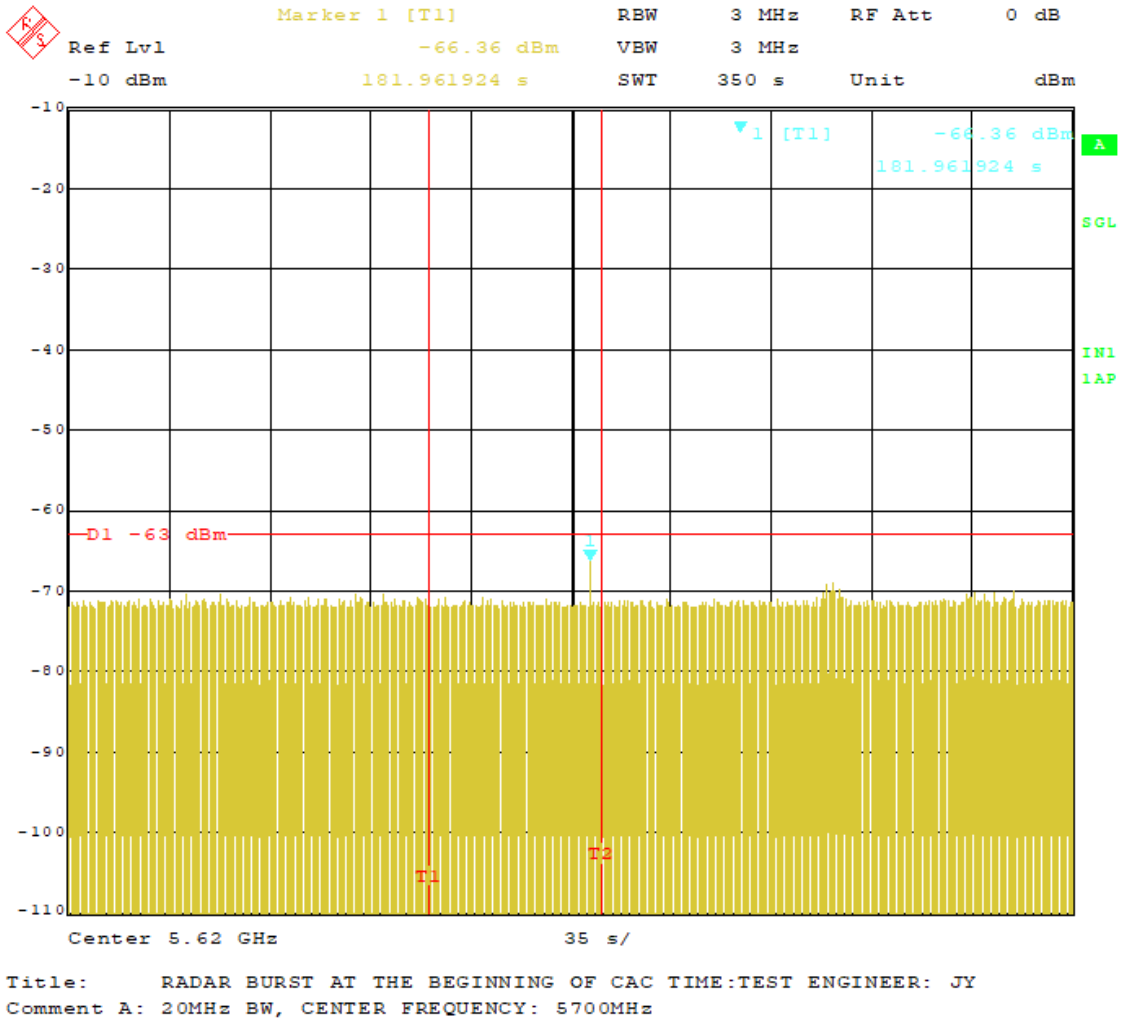
- Connect the Radar Waveform generator and EUT together with the EUT power off.
- Set the power level of radar test signal.
- The EUT is powered on at T_0 and completes its power-up sequence (T_{power_up}) at T_1.
- The Channel Availability Check Time commences on Ch_r at instant T_1 and will end no sooner than $T_1 + T_{ch\_avail\_check}$. $T_{ch\_avail\_check} \geq 60$ seconds.
- A single Burst of the Short Pulse Radar Type 1 will commence within a 6 second window starting at T_1+ 54 seconds.
- Visual indication or measured results on the EUT of successful detection of the radar Burst will be recorded and reported. Observation of Ch_r for EUT emissions will continue for 2.5 minutes after the radar Burst has been generated.
- Verify that during the 2.5 minutes measurement window no EUT transmissions occurred on Chr.
- The Channel Availability Check results will be recorded.

Plot of Radar Burst at the End of the Channel Availability Check Time

Channel: Ch 136 @ 5680MHz:
T_1 = 125.55 seconds (power on)
T_2 = 185.87 seconds (CAC ends)
Marker 1 = 181.96 seconds (radar)

The plot below shows that the CAC started after power-up at T_1 = 125.55 seconds. The earliest time that CAC should end is T_1 + 60 seconds = 185.55 seconds and the radar signal should be injected after T_1 + 54 seconds = 179.55 seconds. Since $T_{ch\_avail\_check}$ = 60.3 seconds which is larger than 60 seconds, the CAC ends at 185.87 seconds. The 6 seconds window is from 179.55 seconds (T_1 + 54 = 179.55 seconds) to 185.55 seconds. In other words, the radar signal should not be injected sooner than at 179.55 seconds. From the plot below, the radar signal was injected at 181.96 seconds which is within 6 seconds window before the CAC ends at 185.85 seconds. Observation of Ch_r for EUT emissions continued for 168.04 seconds after the radar burst has been generated.

It was verified that during the 2.5 minutes (150 seconds) measurement window no EUT transmissions occurred on Ch_r.



The results are summarized below:

Table 5.4.2.1 Measurement Results for Channel Availability Check Time Tests

Radar Burst Applied After Reboot	EUT	Results
No Radar Triggered	EUT marks the Channel as active	The initial power-up cycle requires 125.55 seconds; Transmission began on the channel after completion of the initial power-up cycle and the 60.3 seconds CAC.
At 126.95 seconds	EUT indicates the radar detected.	No transmission on channel observed for 2.5 minutes after the radar was detected.
At 181.96 seconds	EUT indicates the radar detected.	No transmission on channel observed for 2.5 minutes after the radar was detected.

5.4.3 In Service Monitoring

In Service Monitoring will verify Channel Move Time, Channel Closing Transmission Time and Non-Occupancy Period. After a radar's presence is detected, all transmissions shall cease on the operating channel within 10 seconds (see Table 4.3.3):

- Transmission during this period shall consist of normal traffic for a maximum of 200ms after detection of the radar signal.
- In addition, intermittent management and control signals can be sent during the remaining time to facilitate vacating the operating channel.

These tests define how the following DFS parameters are verified during In-Service Monitoring:

- Channel Closing Transmission Time: 200 ms + an aggregate of 60 ms over remaining 10s period.
- Channel Move Time: 10 seconds
- Non-Occupancy Period: No EUT transmissions were observed on the test channel during the 30 min observation period. The non-occupancy period starts at the time when the radar system is detected.

The steps were used to determine the above mentioned parameters.

- Set the Operating Channel.
- Associate a U-NII client device with the EUT (Master).
- Start the Radar Waveform generator. For radiated tests, the emissions of the *Radar Waveform* generator will be directed towards the *Master Device*. If the *Master Device* has antenna gain, the main beam of the antenna will be directed toward the radar emitter. Vertical polarization is used for testing.
- Stream the MPEG test file from the Master Device to the Client Device on the test channel for the entire period of the test.
- Set a marker at time M_0 when the Radar Waveform generator sends a burst of pulses for Short Pulse Radar Type 0 on the Operating Channel.
- Observe the transmissions of the EUT at the end of the radar burst on the Operating Channel for duration greater than 10 seconds. M_1 is the instant when the burst ends and M_2 is the instant when EUT transmission ends where M_2-M_1 < 10 seconds. The measurement timing for channel move time and chancel closing time begins at the end of the Radar Type 0 burst.
- Measure and record the Channel Move Time M_2-M_1 and Channel Closing Transmission Time if radar detection occurs.
- Monitor the EUT for more than 30 minutes (Non-Occupancy Period) following instant M_2 to verify that the EUT does not resume any transmissions on this channel. Perform this test once and record the measurement result.
- The Channel Closing Transmission Time is comprised of 200 ms starting at the beginning of the Channel Move Time plus any additional intermittent control signals required to facilitate a Channel move (an aggregate of 60 ms) during the remainder of the 10 second period. The aggregate duration of control signals will not count quiet periods in between transmissions.

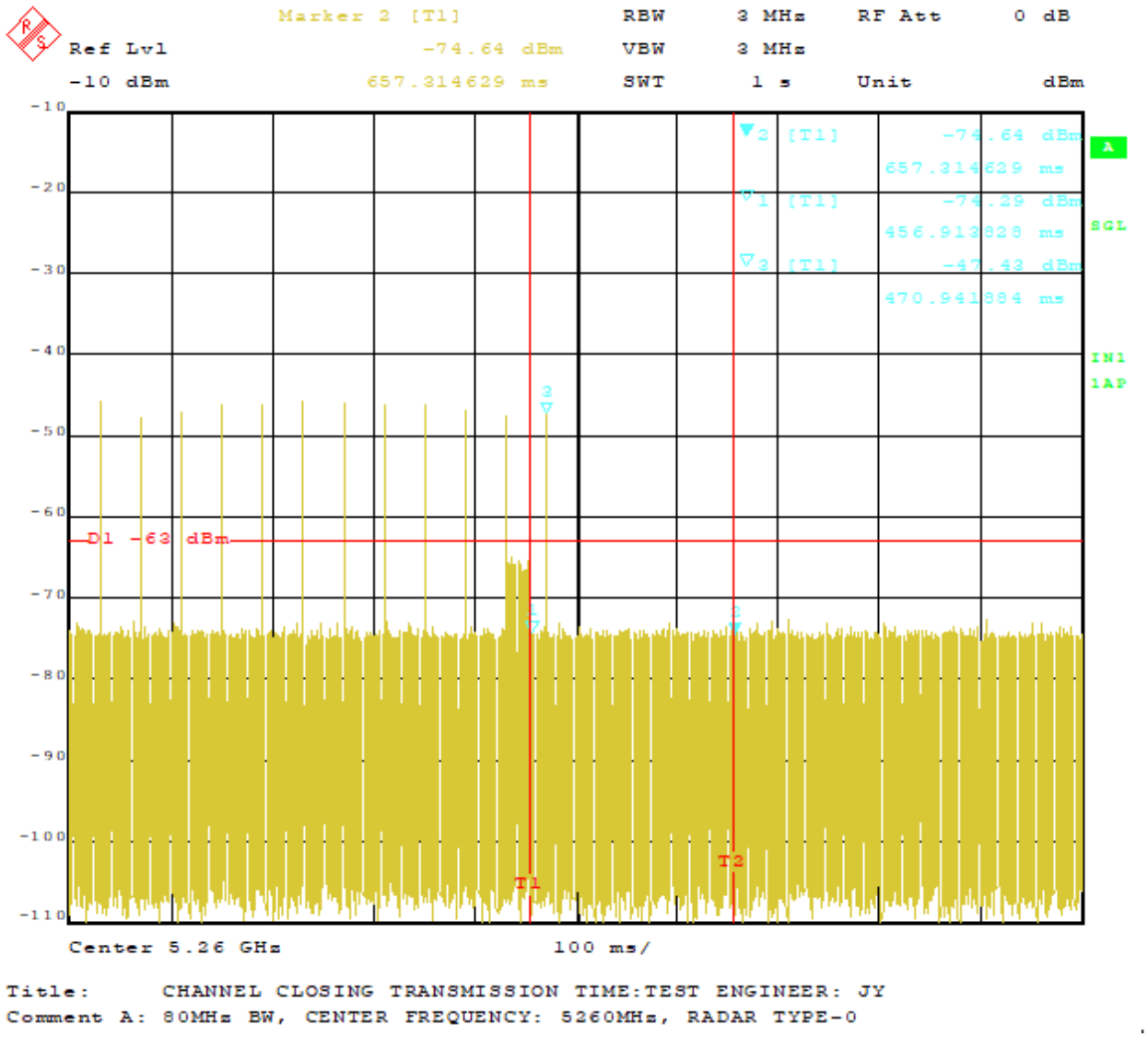
The measurements for Channel Move Time and Channel Closing Transmission Time were performed for a 4x20MHz carrier at Channels 52, 56, 60, 64 (5260, 5280, 5300, 5320 MHz) with Radar Type 0. Non-Occupancy Period has been performed for a 4x20MHz carrier at Channels 132, 136, 140, 144 (5660, 5680, 5700, 5720 MHz) with Radar Type 0.

5.4.3.1 Channel Move Time

Plot of Channel Move Time with Radar Type 0 (Short Pulse Type)

The time when radar burst ended M_1 = 0.457 seconds
The time when Transmission ended M_2 = 0.471 seconds
Channel move time M_2-M_1 = 0.014 seconds < 10 seconds

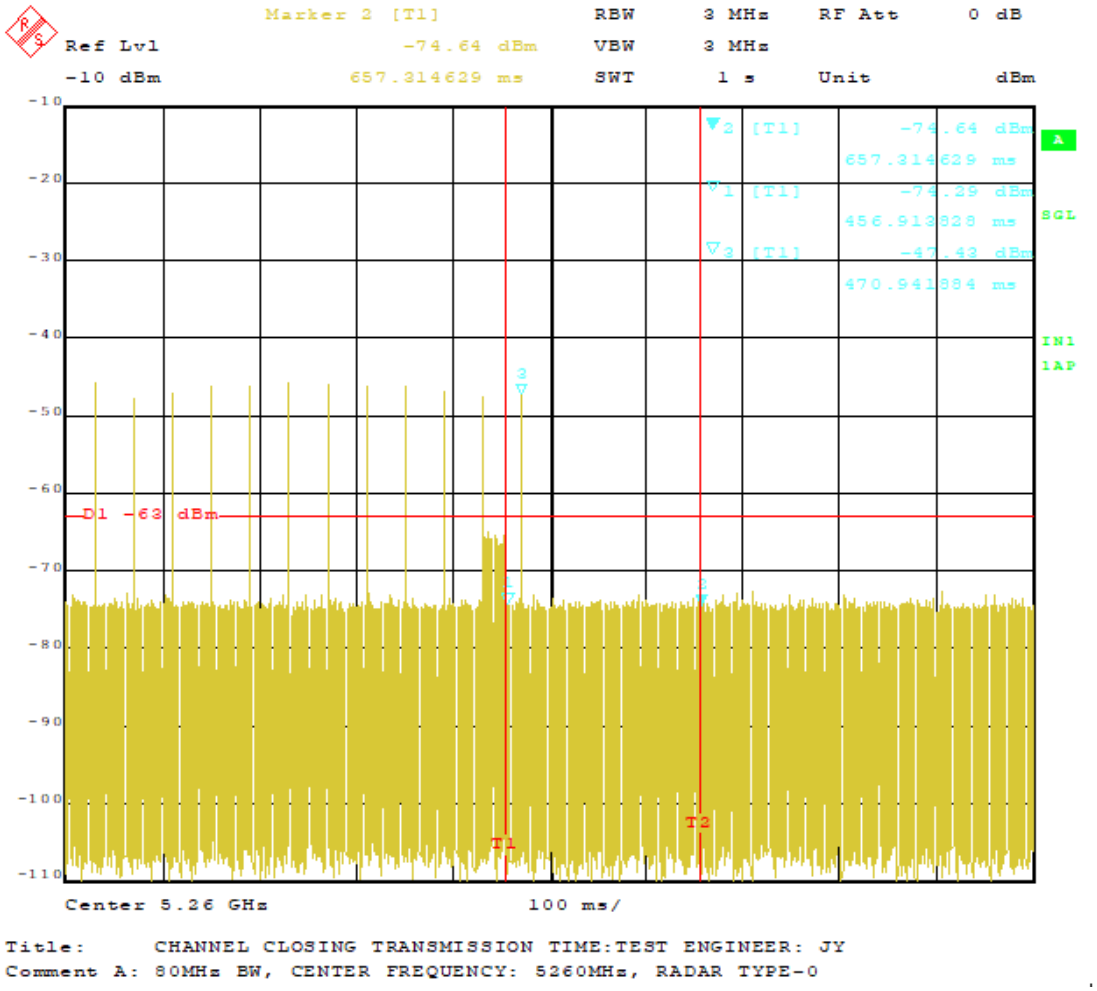
The transmission was observed for over 10 seconds.



5.4.3.2 Channel Closing Transmission Time

Plot of Channel Closing Time with Radar Type #0

The time when radar burst ended M_1 = 0.457 seconds
The time when 200ms after radar ends M_2 = 0.657 seconds



The Upper Bound of the Aggregate Duration of the Channel Closing Transmission Time is estimated below:

D = S / B = 1 seconds /8001 bins = 0.125 ms/bin, and

C = N * D = N bins *0.125 ms/bin < 60 ms.

S is the Sweep Time,
B is the Number of Spectrum Analyzer Sampling Bins,

N is the Number of Spectrum Analyzer Sampling Bins showing a U-NII Transmission (Intermittent Control Signals between the 0.2 seconds after the radar and 10 seconds after the radar),
D is the Dwell Time per Spectrum Analyzer Sampling Bin, and
C is the Aggregated Time of Intermittent Control Signals.

Since N < 480, so C < 60 ms.

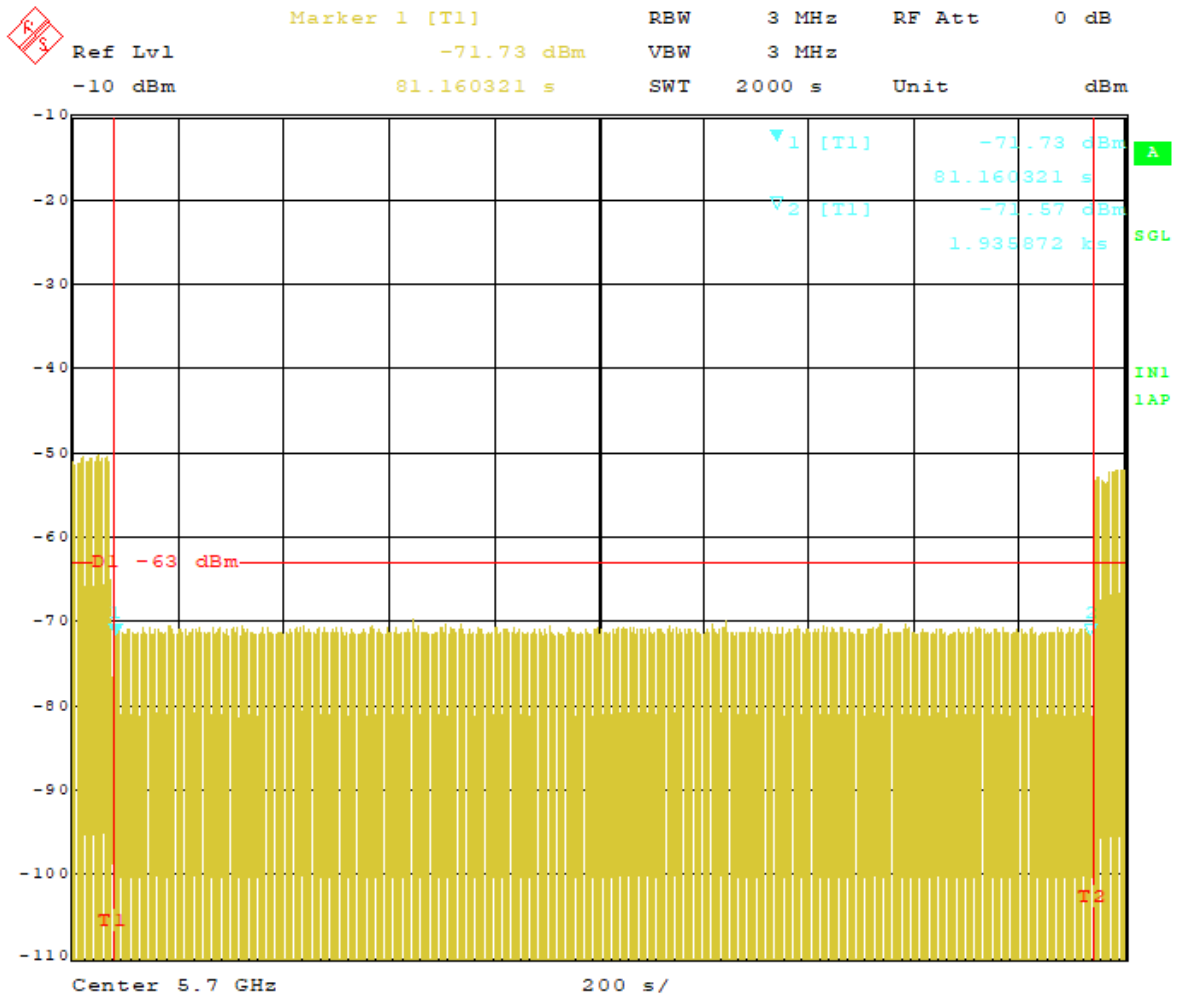
5.4.3.3 Non-Occupancy Period

Plot of Non-Occupancy Period

T_1 = 81.2 seconds (the end of transmission)
T_2 = 1935.9 seconds (the end of non-occupancy period)
T_2 - T_1 = 1854.7 seconds > 30 minutes (1800 seconds)

Non-Occupancy Period > 30 minutes.

The non-occupancy period starts at the time when the channel moves after the radar signal is detected. The radar signal was detected before T_1 and the channel moves at T_1. Therefore, during the 30 minutes observation time after a radar signal was detected on the test channel, the EUT did not make any transmissions on that channel.



Title: NON-OCCUPANCY PERIOD:TEST ENGINEER: JY
Comment A: 80MHz BW, CENTER FREQUENCY: 5700MHz, RADAR TYPE-0

5.4.4 Statistical Performance Check

The purpose of this test is to present a given radar pulse type to the EUT repeatedly to measure the probability of detection in the presence of *traffic*. The requirements are given in Tables 4.5.1, 4.5.2 and 4.5.3.

$$\text{Successful Detection Radar Waveform N (\%)} = P_dN = \frac{Total\ Waveform\ Detections}{Total\ Waveform\ Trials} \times 100.$$

The procedures below provided in KDB 905462 D02 are followed:

- Set the Operating Channel.
- The emissions of the Radar Waveform generator will be directed towards the Master Device. The main beam of the antenna will be directed toward the radar emitter. Vertical polarization is used for testing.
- Stream the MPEG test file from the Master Device to the Client Device on the test Channel for the entire period of the test.
- At time T_0 the Radar Waveform generator sends the individual waveform for each of the Radar Types 1-6 on the Operating Channel.
- Observe the transmissions of the EUT at the end of the Burst on the Operating Channel for duration greater than 10 seconds for Short Pulse Radar Types to ensure detection occurs.
- Observe the transmissions of the EUT at the end of the Burst on the Operating Channel for duration greater than 22 seconds for Long Pulse Radar Type 5 to ensure detection occurs.
- For Radar Type 5, three subsets of trials (minimum 10 trials per subset) need to be performed near low, middle and high of the UUT channel, i.e., 90% of Radar Type 5 frequency modulation is within the low or high edge of the UUT *Occupied Bandwidth.*
- For Radar Types 2-4, a minimum of 30 unique waveforms are required for each.

The results are summarized below:

Table 5.4.4.1 Statistical Performance Check Summary for Test Waveforms Radar Types 1-6 (20MHz)

Radar Type	No. of Trials	No. of Successful Detections	P_dN (%)	Min % of Successful Detections	Min Number of Trials
1A	30	30	100	60	30
1B	30	30	100	60	30
2	30	24	80	60	30
3	30	27	90	60	30
4	30	25	83	60	30
Aggregate (Pd1A + Pd1B+ Pd2 +Pd3+ Pd4)/5 = 91				80	180
5	30	30	100	80	30
6	30	30	100	70	30

Table 5.4.4.2 Statistical Performance Check Summary for Test Waveforms Radar Types 1-6 (2x20MHz)

Radar Type N	No. of Trials	No. of Successful Detections	PdN (%)	Min % of Successful Detections	Minimum No of Trials
1A	30	30	100	60	30
1B	30	30	100	60	30
2	30	30	100	60	30
3	30	30	100	60	30
4	30	30	100	60	30
Aggregate (Pd1A + Pd1B+ Pd2 +Pd3+ Pd4+)/5 = 100				80	180
5	30	30	100	80	30
6	30	30	100	70	30

Table 5.4.4.3 Statistical Performance Check Summary for Test Waveforms Radar Types 1-6 (3x20MHz)

Radar Type N	No. of Trials	No. of Successful Detections	PdN (%)	Min % of Successful Detections	Minimum No of Trials
1A	30	30	100	60	30
1B	30	30	100	60	30
2	30	27	90	60	30
3	30	26	87	60	30
4	30	23	77	60	30
Aggregate (Pd1A + Pd1B+ Pd2 +Pd3+ Pd4)/5 = 91				80	180
5	30	30	100	80	30
6	30	30	100	70	30

Table 5.4.4.4 Statistical Performance Check Summary for Test Waveforms Radar Types 1-6 (4x20MHz)

Radar Type N	No. of Trials	No. of Successful Detections	PdN (%)	Min % of Successful Detections	Minimum No of Trials
1A	30	29	97	60	30
1B	30	30	100	60	30
2	30	30	100	60	30
3	30	30	100	60	30
4	30	30	100	60	30
Aggregate (Pd1A + Pd1B+ Pd2 +Pd3+ Pd4)/5 = 99				80	180
5	30	30	100	80	30
6	30	30	100	70	30

Table 5.4.4.5(a) Statistical Performance Check Summary for Test Waveforms Radar Type 5 (20MHz)

Channels	No. of Trials	No. of Successful Detections	PdN (%)
Low 5491	30	30	100

Middle 5500	30	30	100
High 5510	30	29	97
Total	**90**	**89**	**99**

Table 5.4.4.5(b) Statistical Performance Check Summary for Test Waveforms Radar Type 5 (2x20MHz)

Channels	No. of Trials	No. of Successful Detections	PdN (%)
Low 5500	30	30	100
Middle 5510	30	30	100
High 5520	30	30	100
Total	**90**	**90**	**100**

Table 5.4.4.5(c) Statistical Performance Check Summary for Test Waveforms Radar Type 5 (3x20MHz)

Channels	No. of Trials	No. of Successful Detections	PdN (%)
Low 5500	30	30	100
Middle 5520	30	30	100
High 5540	30	30	100
Total	**90**	**90**	**100**

Table 5.4.4.5(d) Statistical Performance Check Summary for Test Waveforms Radar Type 5 (4x20MHz)

Channels	No. of Trials	No. of Successful Detections	PdN (%)
Low 5500	30	30	100
Middle 5530	30	29	97
High 5560	30	30	100
Total	**90**	**89**	**99**

In the above Statistical Performance Check test, the Radar Waveforms Type 1-6 specified in KDB 905462 D02, presented in Section 4.5 Tables 4.5.1, 4.5.2 and 4.5.3, were used. The pulse generator WaveTest 20 from IXIA technologies, which has the required radar waveforms built in, was used in the tests to generate the required pulses through command scripts. The command script allows to select Channel Frequency, Radar Type, Power and Number of Trials for each radar type. All the waveforms had been verified and calibrated in Section 5.3 by a spectrum analyzer.

The characteristics of Radar Waveform Types 1-6 generated by IXIA pulse generator for a 20MHz carrier at 5500MHz for Statistic Performance Check tests, such as pulse width, pulse repetition interval, number of pulses per burst, etc., are provided in the following Tables 5.4.4.5-10.

Table 5.4.4.5(a) Statistical Performance Check - Test Waveforms Radar Type 1a Characteristics

Trial No	Pulse Width (µs)	PRI (µs)	No of Pulses
1	1	518	102
2	1	558	95
3	1	598	89
4	1	638	83
5	1	658	81
6	1	678	78
7	1	698	76
8	1	718	74
9	1	758	70
10	1	778	68
11	1	838	63
12	1	878	61
13	1	898	59
14	1	918	58
15	1	938	57

Table 5.4.4.5(b) Statistical Performance Check - Test Waveforms Radar Type 1b Characteristics

Trial No	Pulse Width (µs)	PRI (µs)	No of Pulses
1	1	538	99
2	1	578	92
3	1	618	86
4	1	640	83
5	1	660	80
6	1	680	78
7	1	700	76
8	1	720	74
9	1	738	72
10	1	760	70
11	1	779	68
12	1	801	66
13	1	818	65
14	1	840	63
15	1	861	62

Table 5.4.4.6 Statistical Performance Check - Test Waveforms Radar Type 2 Characteristics

Trial No	Pulse Width (µs)	PRI (µs)	No of Pulses
1	2.4	155	23
2	2.9	219	26
3	2.9	209	26
4	4.6	190	26
5	4.2	175	29
6	1.4	222	25

7	2.4	162	25
8	5.0	220	23
9	3.6	203	27
10	4.4	192	23
11	1.3	170	26
12	4.0	162	25
13	3.0	152	24
14	4.7	164	23
15	3.5	162	26
16	3.7	200	26
17	1.9	175	26
18	3.8	160	27
19	2.1	226	28
20	4.1	183	29
21	4.7	172	27
22	2.8	156	29
23	2.8	197	27
24	2.5	175	29
25	4.2	213	27
26	2.6	163	26
27	1.3	213	27
28	2.4	208	28
29	1.1	221	26
30	3.2	153	24

Table 5.4.4.7 Statistical Performance Check - Test Waveforms Radar Type 3 Characteristics

Trial No	Pulse Width (µs)	PRI (µs)	No of Pulses
1	7.0	230	17
2	7.1	355	17
3	7.9	388	17
4	10.0	453	17
5	8.4	302	18
6	8.2	216	16
7	6.4	487	16
8	8.2	331	16
9	6.5	210	17
10	8.1	206	16
11	6.8	477	18
12	9.8	209	17
13	7.0	337	16
14	7.0	407	17
15	7.9	466	18
16	6.0	291	18
17	8.7	273	17
18	8.2	462	16
19	9.8	260	16

20	10.0	355	16
21	6.6	439	18
22	6.9	222	18
23	6.8	435	17
24	9.2	333	18
25	9.1	377	16
26	7.2	415	16
27	7.6	459	17
28	9.8	428	16
29	6.0	371	18
30	6.9	312	17

Table 5.4.4.8 Statistical Performance Check - Test Waveforms Radar Type 4 Characteristics

Trial No	Pulse Width (µs)	PRI (µs)	No of Pulses
1	11.0	386	12
2	17.5	324	16
3	14.5	212	15
4	13.4	263	12
5	18.2	487	13
6	11.0	212	13
7	12.5	238	13
8	18.9	454	15
9	17.9	267	14
10	12.5	316	12
11	12.0	214	13
12	19.2	317	15
13	13.1	306	12
14	19.8	413	12
15	16.5	205	14
16	17.5	411	12
17	14.0	421	15
18	14.0	456	13
19	12.3	374	14
20	17.3	379	15
21	15.4	386	13
22	16.6	220	13
23	19.9	438	16
24	12.6	311	15
25	13.3	282	13
26	16.6	364	13
27	14.4	435	16
28	17.3	362	14
29	17.2	201	15
30	12.6	484	14

Table 5.4.4.9 Statistical Performance Check - Test Waveforms Radar Type 5 Characteristics

Tria1 No	Burst No	Pulse Width (µs)	PRI (µs)	Chirp Width (MHz)	No of Pulses per Burst
1	1	57.6	1472, 1130, 0	5	2
1	2	57.9	1317, 1211, 1295	7	3
1	3	77.1	1248, 0, 0	16	1
1	4	83.6	1889, 1974, 0	10	2
1	5	77.9	1801, 0, 0	11	1
1	6	91.9	1797, 1952, 1784	12	3
1	7	89.7	1788, 1340, 0	9	2
1	8	59.7	1494, 1186, 1089	10	3
1	9	70.9	1211, 0, 0	8	1
1	10	54.3	1220, 0, 0	18	1
2	1	57.3	1942, 0, 0	5	1
2	2	85.1	1878, 1371, 0	17	2
2	3	83.7	1265, 1798, 1572	10	3
2	4	74.0	1616, 0, 0	11	1
2	5	67.1	1009, 1230, 1494	15	3
2	6	87.6	1533, 1581, 1671	14	3
2	7	86.9	1018, 0, 0	8	1
2	8	63.2	1312, 1386, 0	17	2
2	9	75.0	1184, 1261, 0	16	2
2	10	90.6	1902, 0, 0	17	1
2	11	83.6	1270, 1346, 1408	17	3
2	12	50.3	1014, 1664, 0	18	2
2	13	80.1	1062, 1442, 0	14	2
2	14	84.5	1413, 0, 0	5	1
2	15	98.2	1136, 1706, 0	9	2
3	1	75.6	1573, 1762, 0	7	2
3	2	92.2	1223, 1875, 1743	15	3
3	3	67.4	1985, 1128, 0	13	2
3	4	79.2	1416, 1124, 0	14	2
3	5	57.6	1234, 1683, 0	17	2
3	6	94.6	1592, 1373, 0	5	2
3	7	89.0	1343, 1565, 0	12	2
3	8	86.2	1555, 1289, 1340	6	3
3	9	83.6	1489, 0, 0	13	1
3	10	61.5	1646, 0, 0	16	1
3	11	66.3	1217, 0, 0	12	1

3	12	95.5	1849, 1396, 1721	5	3
3	13	65.9	1841, 1763, 0	8	2
4	1	57.1	1798, 0, 0	13	1
4	2	96.9	1501, 1190, 0	14	2
4	3	87.7	1235, 0, 0	18	1
4	4	56.2	1758, 1830, 1243	14	3
4	5	62.3	1365, 1984, 1129	8	3
4	6	57.0	1754, 0, 0	20	1
4	7	88.5	1552, 1412, 1713	11	3
4	8	57.3	1282, 1675, 0	19	2
4	9	66.6	1848, 1180, 0	10	2
5	1	84.8	1548, 1897, 1375	13	3
5	2	91.0	1091, 0, 0	11	1
5	3	63.5	1326, 0, 0	8	1
5	4	70.2	1074, 1923, 0	5	2
5	5	94.6	1155, 0, 0	20	1
5	6	69.6	1762, 0, 0	7	1
5	7	96.4	1960, 0, 0	5	1
5	8	95.6	1118, 0, 0	14	1
5	9	60.7	1586, 0, 0	14	1
6	1	70.0	1826, 1764, 0	10	2
6	2	77.4	1710, 1525, 0	13	2
6	3	94.8	1425, 0, 0	6	1
6	4	72.6	1651, 1610, 1052	19	3
6	5	94.1	1325, 1863, 1173	7	3
6	6	95.7	1995, 1038, 0	16	2
6	7	73.1	1483, 0, 0	20	1
6	8	82.3	1531, 1569, 0	20	2
6	9	85.4	1869, 1235, 0	5	2
6	10	63.1	1378, 1033, 0	6	2
6	11	54.1	1984, 1968, 1364	18	3
6	12	83.6	1216, 0, 0	10	1
6	13	99.8	1191, 1758, 1704	6	3
7	1	94.4	1675, 0, 0	10	1
7	2	90.0	1855, 1478, 0	12	2
7	3	53.1	1198, 0, 0	11	1
7	4	79.8	1437, 0, 0	9	1

7	5	56.8	1368, 0, 0	16	1
7	6	94.8	1485, 0, 0	15	1
7	7	50.4	1473, 1541, 0	12	2
7	8	67.0	1177, 1065, 0	18	2
7	9	74.3	1497, 1443, 1566	9	3
7	10	62.8	1671, 0, 0	11	1
7	11	77.3	1130, 0, 0	17	1
7	12	91.1	1549, 0, 0	12	1
7	13	84.0	1755, 1103, 1413	6	3
7	14	74.6	1513, 1426, 1812	14	3
7	15	90.3	1639, 0, 0	7	1
7	16	68.5	1070, 1216, 0	14	2
7	17	63.2	1802, 1281, 1454	11	3
7	18	60.1	1462, 0, 0	17	1
8	1	74.6	1866, 0, 0	8	1
8	2	73.8	1898, 1622, 0	12	2
8	3	73.5	1822, 0, 0	10	1
8	4	79.7	1692, 1357, 1521	11	3
8	5	53.8	1763, 1486, 0	20	2
8	6	78.8	1555, 1460, 1966	9	3
8	7	76.6	1486, 1937, 0	11	2
8	8	81.4	1959, 1363, 1750	11	3
8	9	95.0	1058, 0, 0	7	1
8	10	54.1	1439, 1303, 1152	8	3
8	11	68.6	1852, 1034, 1797	20	3
8	12	62.4	1390, 1437, 1040	6	3
8	13	67.1	1678, 0, 0	10	1
8	14	50.6	1079, 1111, 0	8	2
8	15	53.4	1071, 1435, 1265	8	3
8	16	65.8	1337, 1510, 0	15	2
8	17	87.9	1055, 1742, 1465	6	3
9	1	70.2	1445, 0, 0	15	1
9	2	71.9	1064, 0, 0	9	1
9	3	63.0	1389, 1749, 0	20	2
9	4	53.6	1017, 1673, 0	14	2
9	5	94.3	1840, 1395, 1295	7	3
9	6	77.6	1380, 0, 0	17	1
9	7	51.8	1015, 1639, 1379	6	3
9	8	88.0	1454, 1680, 1748	12	3

9	9	69.7	1088, 1103, 0	11	2
9	10	76.5	1204, 1955, 0	20	2
9	11	91.1	1294, 0, 0	14	1
9	12	62.4	1565, 1015, 0	15	2
9	13	68.2	1483, 0, 0	8	1
9	14	50.7	1873, 1085, 0	14	2
9	15	76.5	1299, 1869, 1311	15	3
9	16	81.2	1922, 0, 0	9	1
9	17	64.9	1248, 0, 0	15	1
9	18	57.6	1920, 1031, 0	13	2
10	1	64.7	1278, 0, 0	18	1
10	2	62.9	1531, 1158, 1180	20	3
10	3	92.7	1685, 1958, 1617	19	3
10	4	99.7	1407, 1657, 1750	7	3
10	5	69.4	1974, 1708, 0	20	2
10	6	61.4	1986, 1338, 1832	6	3
10	7	55.4	1817, 1994, 1050	6	3
10	8	72.4	1991, 1180, 0	15	2
10	9	55.2	1315, 0, 0	10	1
10	10	60.3	1322, 1858, 0	14	2
10	11	98.0	1647, 1810, 0	5	2
10	12	69.2	1122, 1087, 0	17	2
10	13	86.7	1532, 1697, 0	17	2
11	1	88.9	1300, 0, 0	14	1
11	2	70.5	1889, 1659, 1344	19	3
11	3	92.5	1143, 0, 0	7	1
11	4	92.1	1963, 1378, 0	13	2
11	5	90.7	1122, 1280, 0	15	2
11	6	93.1	1184, 0, 0	20	1
11	7	89.0	1042, 0, 0	20	1
11	8	88.7	1468, 1993, 0	16	2
11	9	99.0	1012, 1777, 1411	16	3
11	10	87.2	1837, 1175, 0	18	2
11	11	92.1	1953, 0, 0	9	1
11	12	56.1	1509, 1517, 0	20	2
11	13	81.5	1736, 1308, 1471	14	3
11	14	68.7	1906, 1554, 1481	8	3
11	15	84.5	1321, 1636, 1784	18	3
11	16	95.8	1703, 1951, 0	20	2

11	17	98.4	1929, 1062, 0	11	2
11	18	75.3	1559, 0, 0	14	1
11	19	81.0	1320, 1820, 0	11	2
11	20	68.3	1668, 1061, 1784	19	3
12	1	97.0	1905, 0, 0	7	1
12	2	66.4	1232, 0, 0	5	1
12	3	95.0	1692, 0, 0	16	1
12	4	65.0	1965, 0, 0	6	1
12	5	94.6	1405, 1766, 1110	15	3
12	6	67.7	1244, 0, 0	16	1
12	7	61.9	1138, 0, 0	13	1
12	8	53.8	1296, 0, 0	12	1
12	9	80.3	1541, 1498, 1900	11	3
13	1	83.5	1588, 0, 0	19	1
13	2	54.9	1344, 1822, 1658	13	3
13	3	63.6	1594, 1652, 1749	10	3
13	4	78.3	1243, 0, 0	11	1
13	5	58.7	1757, 1822, 1638	13	3
13	6	98.3	1853, 1306, 1329	14	3
13	7	50.4	1532, 1007, 1730	12	3
13	8	70.0	1269, 1033, 1602	19	3
13	9	96.3	1459, 1975, 1119	9	3
13	10	53.9	1202, 0, 0	6	1
13	11	53.0	1825, 0, 0	18	1
13	12	76.6	1468, 0, 0	14	1
13	13	61.3	1945, 1985, 0	18	2
13	14	90.8	1083, 1336, 1880	16	3
13	15	52.4	1453, 1092, 1637	15	3
13	16	89.7	1512, 1726, 1853	17	3
13	17	56.7	1197, 1448, 0	17	2
13	18	80.2	1295, 1787, 0	18	2
13	19	72.9	1422, 1228, 1467	12	3
14	1	79.3	1937, 1669, 0	15	2
14	2	59.2	1622, 1289, 0	11	2
14	3	64.1	1738, 0, 0	15	1
14	4	80.6	1457, 1516, 0	15	2
14	5	63.6	1310, 0, 0	17	1
14	6	60.7	1481, 1007, 0	17	2

14	7	55.2	1742, 1134, 1606	20	3
14	8	86.9	1778, 0, 0	13	1
14	9	67.1	1650, 1269, 1217	20	3
14	10	76.0	1896, 1508, 1114	9	3
14	11	63.2	1565, 1510, 0	14	2
14	12	88.0	1101, 1274, 1577	12	3
14	13	54.4	1505, 0, 0	5	1
15	1	79.2	1196, 1850, 0	10	2
15	2	87.1	1273, 1715, 0	10	2
15	3	76.0	1899, 1607, 0	19	2
15	4	89.0	1195, 1734, 0	7	2
15	5	89.4	1818, 1073, 1762	16	3
15	6	88.6	1653, 1939, 0	12	2
15	7	61.9	1235, 1273, 1597	14	3
15	8	76.7	1351, 1521, 0	20	2
15	9	93.6	1931, 1135, 0	20	2
15	10	58.7	1701, 0, 0	7	1
15	11	96.0	1190, 0, 0	12	1
15	12	77.0	1418, 0, 0	15	1
15	13	55.5	1744, 1212, 0	9	2
15	14	95.6	1371, 1240, 1658	6	3
15	15	76.9	1455, 1065, 1393	17	3
15	16	71.9	1616, 1267, 0	11	2
15	17	57.1	1984, 0, 0	6	1
15	18	54.5	1587, 1689, 0	17	2
15	19	65.0	1417, 0, 0	12	1
15	20	95.2	1768, 0, 0	16	1
16	1	82.7	1075, 0, 0	16	1
16	2	77.1	1473, 1670, 0	12	2
16	3	93.6	1867, 0, 0	7	1
16	4	60.2	1514, 1680, 1919	10	3
16	5	74.2	1834, 1841, 0	16	2
16	6	91.1	1877, 1452, 0	10	2
16	7	58.8	1433, 1653, 0	15	2
16	8	62.7	1740, 1278, 1451	18	3
16	9	50.7	1117, 1812, 0	19	2
16	10	68.7	1831, 1265, 1355	7	3
16	11	53.9	1834, 0, 0	14	1
16	12	64.5	1392, 1120, 1600	6	3

16	13	83.3	1906, 0, 0	16	1
16	14	62.3	1518, 0, 0	5	1
16	15	61.2	1074, 1795, 0	19	2
16	16	77.7	1903, 0, 0	14	1
16	17	67.8	1457, 1236, 0	9	2
16	18	96.5	1263, 1537, 1817	13	3
16	19	69.3	1201, 1988, 0	20	2
17	1	75.4	1086, 1959, 1317	10	3
17	2	73.6	1060, 1435, 1505	10	3
17	3	65.7	1844, 1927, 1679	19	3
17	4	74.1	1325, 1018, 1055	18	3
17	5	95.7	1962, 1624, 0	13	2
17	6	83.7	1776, 0, 0	8	1
17	7	57.1	1039, 0, 0	14	1
17	8	51.1	1938, 0, 0	8	1
17	9	71.3	1215, 1658, 1032	12	3
18	1	88.0	1740, 1597, 0	14	2
18	2	69.6	1340, 0, 0	13	1
18	3	82.6	1991, 1455, 0	10	2
18	4	87.3	1086, 1703, 0	20	2
18	5	60.3	1576, 1229, 0	12	2
18	6	94.2	1466, 1018, 1808	8	3
18	7	70.8	1554, 0, 0	15	1
18	8	74.5	1778, 1706, 1393	15	3
19	1	60.0	1083, 0, 0	12	1
19	2	61.7	1792, 0, 0	17	1
19	3	82.0	1914, 1937, 0	9	2
19	4	79.2	1409, 0, 0	8	1
19	5	80.6	1006, 1461, 1679	16	3
19	6	57.8	1016, 1918, 1628	10	3
19	7	57.3	1586, 0, 0	9	1
19	8	75.0	1553, 1707, 0	7	2
19	9	67.2	1687, 1246, 0	17	2
19	10	67.2	1544, 1292, 1921	18	3
19	11	50.3	1799, 1439, 1230	16	3
20	1	92.8	1258, 0, 0	17	1
20	2	58.3	1009, 0, 0	15	1

20	3	59.2	1871, 0, 0	6	1
20	4	89.8	1237, 1935, 0	10	2
20	5	68.5	1652, 1470, 1337	9	3
20	6	58.5	1126, 1936, 1804	6	3
20	7	53.8	1995, 1535, 1249	5	3
20	8	53.4	1087, 1020, 1414	16	3
20	9	82.5	1299, 0, 0	18	1
20	10	56.1	1368, 1716, 0	15	2
20	11	92.3	1994, 1763, 1312	8	3
21	1	88.5	1682, 1600, 1749	17	3
21	2	51.2	1008, 1131, 0	14	2
21	3	66.5	1206, 1122, 0	20	2
21	4	89.2	1205, 0, 0	10	1
21	5	56.4	1575, 1482, 0	14	2
21	6	64.2	1704, 0, 0	19	1
21	7	74.8	1005, 1077, 0	9	2
21	8	79.4	1911, 1084, 1307	19	3
21	9	51.7	1295, 1119, 1624	15	3
21	10	59.1	1488, 1076, 1096	16	3
21	11	54.2	1718, 1120, 0	6	2
21	12	87.1	1073, 1987, 0	15	2
21	13	72.8	1341, 0, 0	10	1
21	14	74.8	1294, 0, 0	17	1
21	15	75.4	1814, 1606, 0	7	2
21	16	89.8	1381, 0, 0	14	1
21	17	93.5	1041, 1591, 0	12	2
21	18	80.2	1152, 0, 0	16	1
21	19	68.7	1242, 1215, 1944	8	3
22	1	87.9	1680, 0, 0	5	1
22	2	93.0	1805, 1085, 0	15	2
22	3	91.9	1917, 1926, 1277	12	3
22	4	76.5	1311, 1015, 1970	17	3
22	5	97.7	1005, 0, 0	16	1
22	6	83.2	1861, 1135, 0	5	2
22	7	51.8	1241, 0, 0	11	1
22	8	74.3	1106, 1514, 1183	17	3
23	1	62.0	1820, 0, 0	16	1
23	2	62.6	1337, 1464, 0	5	2

23	3	68.5	1827, 1627, 1216	15	3
23	4	76.2	1093, 0, 0	6	1
23	5	82.0	1970, 1614, 1536	13	3
23	6	81.1	1376, 1565, 0	20	2
23	7	56.5	1198, 0, 0	10	1
23	8	53.6	1892, 0, 0	7	1
23	9	84.3	1985, 0, 0	20	1
23	10	81.0	1657, 1809, 0	12	2
23	11	95.3	1902, 0, 0	18	1
23	12	78.2	1060, 0, 0	8	1
23	13	62.5	1143, 1436, 1634	17	3
24	1	88.9	1304, 1032, 0	5	2
24	2	66.6	1935, 0, 0	14	1
24	3	70.0	1020, 0, 0	18	1
24	4	70.2	1949, 1434, 1376	15	3
24	5	93.9	1646, 0, 0	10	1
24	6	64.5	1437, 1651, 1468	9	3
24	7	85.3	1771, 0, 0	14	1
24	8	96.7	1208, 0, 0	19	1
24	9	65.2	1601, 0, 0	16	1
24	10	82.6	1139, 0, 0	9	1
25	1	77.8	1811, 1881, 0	19	2
25	2	62.6	1157, 0, 0	19	1
25	3	94.9	1340, 1295, 0	17	2
25	4	90.2	1911, 1561, 1080	11	3
25	5	90.3	1237, 1790, 0	12	2
25	6	59.5	1060, 1252, 1083	20	3
25	7	52.6	1272, 1770, 0	11	2
25	8	50.4	1524, 1549, 0	18	2
25	9	98.1	1248, 1729, 1064	13	3
25	10	55.5	1000, 1351, 0	12	2
25	11	86.5	1606, 1231, 0	14	2
25	12	71.1	1635, 0, 0	15	1
25	13	58.6	1175, 1794, 0	16	2
25	14	77.2	1445, 1372, 0	15	2
25	15	70.6	1816, 0, 0	7	1
26	1	94.3	1801, 0, 0	5	1
26	2	73.8	1004, 1555, 1440	6	3

26	3	53.2	1293, 0, 0	5	1
26	4	51.3	1047, 1692, 0	13	2
26	5	70.0	1693, 0, 0	7	1
26	6	98.8	1577, 0, 0	13	1
26	7	57.7	1266, 0, 0	11	1
26	8	89.9	1265, 1596, 0	17	2
26	9	50.4	1304, 1249, 1171	8	3
26	10	77.7	1762, 0, 0	7	1
26	11	64.4	1826, 1470, 1141	18	3
26	12	82.8	1948, 1440, 0	9	2
27	1	56.5	1811, 1371, 1118	15	3
27	2	56.8	1382, 1802, 0	11	2
27	3	52.1	1259, 1621, 1389	17	3
27	4	65.8	1720, 0, 0	10	1
27	5	63.5	1233, 1050, 1012	19	3
27	6	77.6	1126, 1682, 1928	12	3
27	7	69.0	1102, 1299, 1668	18	3
27	8	91.1	1915, 1808, 1571	8	3
27	9	83.7	1602, 0, 0	12	1
28	1	56.1	1380, 1774, 1295	7	3
28	2	60.2	1421, 1871, 1820	12	3
28	3	92.7	1615, 1305, 1610	19	3
28	4	74.4	1128, 1561, 0	15	2
28	5	50.5	1828, 0, 0	8	1
28	6	53.0	1462, 1933, 0	6	2
28	7	78.0	1014, 0, 0	6	1
28	8	51.1	1099, 1665, 0	15	2
28	9	75.8	1973, 1713, 0	11	2
28	10	88.2	1695, 0, 0	17	1
28	11	72.0	1537, 0, 0	13	1
28	12	96.3	1382, 1047, 1393	16	3
28	13	58.2	1763, 1956, 1034	17	3
29	1	54.7	1325, 1977, 1539	14	3
29	2	51.0	1144, 1155, 0	20	2
29	3	69.9	1423, 1239, 0	10	2
29	4	63.6	1720, 1340, 1162	5	3
29	5	65.1	1765, 1357, 0	11	2
29	6	57.5	1607, 0, 0	16	1

29	7	53.4	1116, 1997, 0	15	2
29	8	86.2	1522, 1888, 1988	11	3
29	9	84.5	1887, 1135, 1727	17	3
29	10	82.5	1755, 0, 0	6	1
29	11	86.8	1012, 0, 0	11	1
29	12	52.0	1546, 1976, 1621	12	3
29	13	98.8	1401, 1093, 1030	19	3
29	14	77.1	1212, 1485, 0	9	2
30	1	78.5	1277, 0, 0	20	1
30	2	86.5	1508, 0, 0	11	1
30	3	80.1	1873, 0, 0	9	1
30	4	91.0	1513, 1536, 0	8	2
30	5	95.3	1368, 1835, 0	14	2
30	6	89.5	1955, 0, 0	6	1
30	7	62.2	1632, 0, 0	15	1
30	8	54.3	1259, 0, 0	19	1
30	9	86.5	1563, 1342, 1583	6	3
30	10	82.5	1910, 0, 0	8	1
30	11	77.8	1558, 1452, 1510	18	3

Table 5.4.4.10 Statistical Performance Check Test Waveforms Radar Type 6 Characteristics

Tria1 No	Hopping Frequencies (MHz)
1	5405, 5296, 5541, 5579, 5675, 5379, 5551, 5644, 5284, 5458, 5258, 5624, 5360, 5626, 5450, 5455, 5270, 5505, 5477, 5598, 5297, 5397, 5663, 5660, 5486, 5712, 5513, 5478, 5349, 5416, 5403, 5635, 5657, 5283, 5600, 5506, 5250, 5496, 5501, 5623, 5350, 5325, 5301, 5632, 5345, 5257, 5552, 5375, 5318, 5409, 5581, 5333, 5721, 5643, 5282, 5465, 5509, 5290, 5694, 5692, 5621, 5706, 5460, 5370, 5594, 5699, 5609, 5498, 5526, 5335, 5502, 5510, 5469, 5456, 5584, 5278, 5414, 5366, 5314, 5489, 5362, 5583, 5625, 5402, 5720, 5286, 5679, 5654, 5346, 5555, 5683, 5547, 5317, 5686, 5586, 5640, 5688, 5492, 5291, 5420
2	5272, 5252, 5616, 5400, 5475, 5508, 5388, 5264, 5315, 5433, 5375, 5590, 5617, 5528, 5402, 5497, 5685, 5266, 5387, 5724, 5292, 5662, 5676, 5261, 5427, 5395, 5425, 5362, 5492, 5262, 5693, 5531, 5512, 5604, 5333, 5560, 5368, 5265, 5661, 5380, 5323, 5698, 5568, 5293, 5366, 5327, 5523, 5484, 5554, 5592, 5454, 5445, 5430, 5435, 5426, 5360, 5702, 5574, 5349, 5679, 5342, 5504, 5709, 5576, 5437, 5290, 5532, 5703, 5589, 5687, 5625, 5650, 5294, 5397, 5712, 5655, 5461, 5363, 5708, 5521, 5280, 5396, 5391, 5316, 5285, 5463, 5440, 5460, 5469, 5509, 5721, 5642, 5334, 5340, 5251, 5694, 5578, 5533, 5545, 5598
3	5674, 5634, 5685, 5541, 5608, 5477, 5647, 5640, 5317, 5689, 5265, 5461, 5369, 5274, 5313, 5295, 5632, 5586, 5383, 5551, 5360, 5262, 5298, 5331, 5452, 5637, 5501, 5314, 5325, 5722, 5509, 5433, 5350, 5682, 5520, 5373, 5671, 5609, 5469, 5681, 5564, 5623, 5436, 5297, 5308, 5443, 5408, 5610, 5272, 5662, 5299, 5347, 5351, 5591, 5391, 5448, 5507, 5335, 5548, 5596, 5333, 5480, 5396, 5602, 5524, 5605, 5653, 5281, 5521, 5549, 5445, 5684, 5251, 5582, 5597, 5626, 5650, 5601, 5512, 5478, 5497, 5446, 5355, 5687, 5400, 5393, 5441, 5271, 5305, 5334, 5346, 5641, 5705, 5407, 5627, 5479, 5659, 5696, 5575, 5613
4	5568, 5507, 5660, 5653, 5668, 5578, 5284, 5352, 5629, 5613, 5511, 5476, 5722, 5461, 5265, 5498, 5255, 5674, 5460, 5701, 5304, 5431, 5436, 5428, 5656, 5536, 5307, 5361, 5491, 5527, 5317, 5404, 5718, 5314, 5558, 5490, 5622, 5647, 5659, 5612, 5559, 5438, 5465, 5389, 5608, 5574, 5642, 5514, 5348, 5693, 5691, 5359, 5643, 5611, 5563, 5586, 5381, 5278, 5459, 5419, 5683, 5481, 5595, 5573, 5273, 5311, 5537, 5463, 5524, 5400, 5396, 5452, 5303, 5489, 5355, 5365, 5483, 5316, 5435, 5417, 5682, 5301, 5335, 5697, 5546, 5280, 5688, 5367, 5666, 5259, 5662, 5296, 5289, 5621, 5723, 5442, 5479, 5320, 5464, 5532
5	5391, 5328, 5552, 5389, 5364, 5709, 5275, 5434, 5653, 5557, 5523, 5634, 5277, 5599, 5497, 5335, 5584, 5388, 5718, 5360, 5561, 5607, 5520, 5494, 5617, 5646, 5708, 5691, 5274, 5702, 5313, 5512, 5637, 5353, 5695, 5664, 5376, 5644, 5696, 5273, 5397, 5334, 5398, 5442, 5408, 5569, 5640, 5572, 5301, 5575, 5712, 5438, 5496, 5322, 5503, 5578, 5534, 5699, 5719, 5622, 5639, 5689, 5629, 5567, 5431, 5396, 5544, 5290, 5500, 5636, 5430, 5678, 5285, 5537, 5588, 5690, 5648, 5339, 5627, 5608, 5387, 5253, 5460, 5549, 5661, 5581, 5421, 5406, 5390, 5505, 5665, 5453, 5263, 5591, 5361, 5429, 5266, 5459, 5686, 5626
6	5693, 5618, 5633, 5417, 5657, 5548, 5273, 5638, 5386, 5354, 5344, 5523, 5681, 5305, 5655, 5527, 5625, 5652, 5632, 5627, 5717, 5418, 5528, 5623, 5616, 5651, 5472, 5351, 5391, 5460, 5484, 5622, 5428, 5562, 5284, 5552, 5511, 5445, 5399, 5529, 5419, 5506, 5407, 5617, 5271, 5551, 5575, 5556, 5403, 5606, 5372, 5331, 5559, 5668, 5375, 5326, 5389, 5719, 5371, 5433, 5349, 5268, 5280, 5721, 5500, 5471, 5421, 5335, 5356, 5665, 5590, 5720, 5277, 5368, 5635, 5479, 5384, 5254, 5673, 5350, 5560, 5423, 5544, 5609, 5703, 5644, 5645, 5459, 5684, 5388, 5413, 5709, 5440, 5293, 5448, 5679, 5712, 5505, 5251, 5360

7	5724, 5512, 5306, 5593, 5417, 5251, 5478, 5455, 5723, 5261, 5277, 5518, 5315, 5641, 5598, 5392, 5459, 5422, 5335, 5498, 5550, 5403, 5350, 5389, 5577, 5676, 5327, 5463, 5257, 5632, 5449, 5578, 5607, 5557, 5543, 5456, 5281, 5436, 5313, 5709, 5284, 5263, 5336, 5349, 5658, 5706, 5659, 5301, 5613, 5617, 5400, 5496, 5642, 5406, 5309, 5445, 5694, 5333, 5378, 5596, 5450, 5660, 5595, 5266, 5551, 5386, 5606, 5621, 5604, 5451, 5648, 5666, 5402, 5701, 5514, 5271, 5618, 5358, 5503, 5388, 5548, 5442, 5314, 5444, 5355, 5494, 5484, 5452, 5720, 5419, 5671, 5334, 5541, 5651, 5558, 5537, 5585, 5525, 5481, 5342
8	5704, 5550, 5302, 5374, 5659, 5661, 5523, 5691, 5371, 5262, 5611, 5654, 5494, 5510, 5431, 5265, 5386, 5593, 5257, 5298, 5264, 5460, 5687, 5554, 5535, 5409, 5608, 5436, 5642, 5622, 5594, 5254, 5581, 5530, 5483, 5410, 5549, 5468, 5437, 5716, 5617, 5613, 5674, 5595, 5536, 5361, 5560, 5697, 5653, 5678, 5269, 5501, 5375, 5658, 5620, 5364, 5627, 5667, 5569, 5689, 5274, 5463, 5304, 5337, 5452, 5485, 5508, 5589, 5357, 5273, 5290, 5679, 5496, 5633, 5397, 5668, 5456, 5457, 5480, 5605, 5438, 5263, 5380, 5303, 5327, 5693, 5343, 5382, 5551, 5709, 5590, 5350, 5660, 5615, 5636, 5405, 5308, 5419, 5513, 5509
9	5465, 5614, 5447, 5559, 5687, 5613, 5339, 5521, 5404, 5642, 5408, 5717, 5480, 5466, 5646, 5294, 5356, 5697, 5587, 5701, 5652, 5604, 5274, 5484, 5520, 5651, 5669, 5635, 5543, 5533, 5325, 5567, 5295, 5562, 5575, 5282, 5500, 5519, 5251, 5525, 5276, 5488, 5396, 5386, 5256, 5293, 5381, 5432, 5670, 5659, 5312, 5612, 5704, 5254, 5405, 5461, 5262, 5419, 5636, 5724, 5394, 5582, 5590, 5591, 5463, 5267, 5387, 5600, 5576, 5346, 5347, 5665, 5608, 5315, 5598, 5671, 5474, 5303, 5310, 5650, 5579, 5710, 5538, 5539, 5352, 5464, 5471, 5684, 5578, 5619, 5661, 5680, 5667, 5384, 5643, 5654, 5320, 5379, 5626, 5580
10	5304, 5627, 5466, 5579, 5633, 5581, 5496, 5320, 5276, 5706, 5278, 5595, 5315, 5484, 5493, 5508, 5457, 5291, 5554, 5456, 5418, 5331, 5600, 5289, 5383, 5701, 5609, 5445, 5610, 5400, 5503, 5509, 5461, 5287, 5308, 5507, 5500, 5715, 5281, 5321, 5519, 5334, 5477, 5267, 5561, 5548, 5721, 5682, 5424, 5596, 5502, 5257, 5298, 5686, 5352, 5656, 5709, 5408, 5417, 5335, 5432, 5423, 5462, 5455, 5557, 5293, 5416, 5450, 5720, 5258, 5369, 5642, 5410, 5475, 5718, 5689, 5473, 5274, 5560, 5577, 5290, 5397, 5375, 5593, 5261, 5448, 5707, 5594, 5326, 5366, 5411, 5713, 5647, 5696, 5708, 5512, 5601, 5392, 5505, 5306
11	5345, 5658, 5477, 5631, 5691, 5324, 5643, 5650, 5397, 5523, 5614, 5583, 5277, 5536, 5538, 5681, 5274, 5562, 5509, 5665, 5349, 5623, 5598, 5541, 5698, 5285, 5490, 5653, 5700, 5336, 5464, 5317, 5524, 5661, 5506, 5580, 5390, 5652, 5588, 5554, 5687, 5481, 5621, 5264, 5355, 5662, 5304, 5522, 5701, 5569, 5564, 5418, 5641, 5531, 5578, 5469, 5419, 5326, 5445, 5669, 5722, 5551, 5360, 5512, 5474, 5340, 5529, 5676, 5313, 5561, 5635, 5695, 5605, 5319, 5295, 5527, 5307, 5639, 5433, 5656, 5422, 5256, 5714, 5587, 5616, 5493, 5303, 5550, 5723, 5258, 5411, 5257, 5573, 5545, 5655, 5322, 5366, 5682, 5558, 5708
12	5287, 5604, 5553, 5305, 5297, 5496, 5492, 5274, 5597, 5349, 5483, 5450, 5665, 5364, 5306, 5506, 5288, 5251, 5372, 5538, 5631, 5673, 5692, 5360, 5323, 5708, 5653, 5670, 5625, 5485, 5296, 5610, 5362, 5400, 5421, 5330, 5386, 5472, 5592, 5263, 5414, 5359, 5381, 5657, 5343, 5716, 5698, 5605, 5667, 5634, 5587, 5387, 5300, 5434, 5379, 5636, 5338, 5408, 5282, 5628, 5473, 5410, 5350, 5452, 5723, 5394, 5302, 5701, 5498, 5666, 5556, 5646, 5703, 5688, 5721, 5398, 5391, 5481, 5523, 5299, 5700, 5428, 5502, 5329, 5375, 5384, 5672, 5606, 5423, 5271, 5569, 5464, 5466, 5469, 5392, 5373, 5668, 5647, 5393, 5380

13	5511, 5371, 5336, 5262, 5626, 5716, 5339, 5637, 5713, 5404, 5597, 5694, 5599, 5318, 5510, 5636, 5382, 5279, 5674, 5679, 5290, 5691, 5331, 5356, 5623, 5376, 5571, 5527, 5556, 5536, 5635, 5656, 5545, 5586, 5308, 5641, 5403, 5394, 5682, 5553, 5466, 5684, 5465, 5259, 5471, 5452, 5506, 5662, 5383, 5347, 5282, 5476, 5319, 5365, 5386, 5700, 5283, 5396, 5717, 5539, 5532, 5379, 5633, 5270, 5325, 5445, 5422, 5412, 5569, 5258, 5306, 5552, 5432, 5355, 5624, 5467, 5374, 5475, 5264, 5267, 5411, 5449, 5587, 5714, 5284, 5675, 5628, 5441, 5575, 5696, 5469, 5274, 5332, 5358, 5659, 5660, 5316, 5488, 5359, 5427
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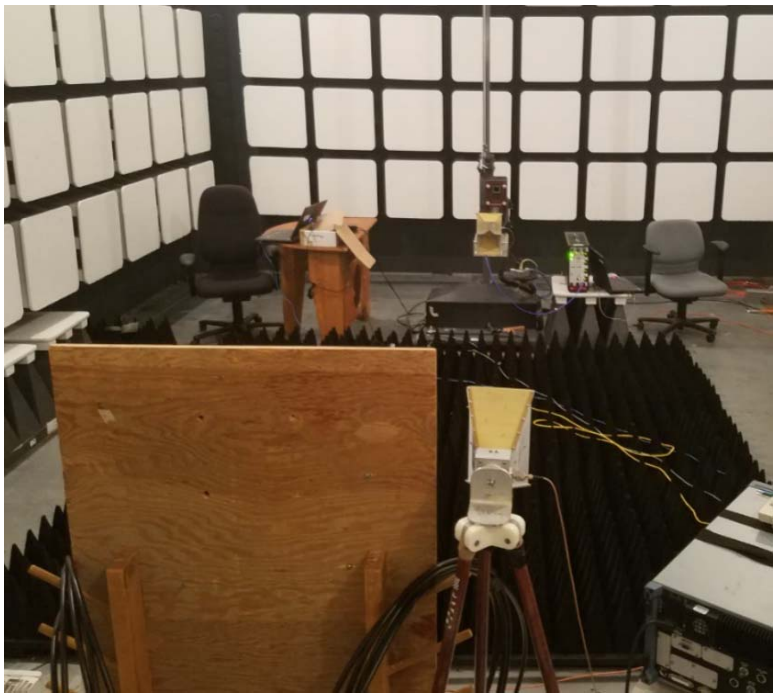
*Pulse Width (μs) = 1; PRI (μs) = 333; No of Pulses per Burst =9 and No of Bursts = 100.

6 PHOTOGRAPHS OF EUT SETUP

The setup photos of the DFS test were provided below.



7 LIST OF TEST EQUIPMENT

Table 7.1 List of Test Equipment Used

Asset ID	Manufacturer	Type	Description	Model	Serial	Calibration Date	Calibration Due	Calibration Type
E514	EMCO	Horn Antenna	Double Ridged Horn 1-18 Ghz	3115	6427	2019-01-23	2021-01-23	Requires Calibration
E518	EMCO	Horn Antenna	Double Ridged Horn 1-18 Ghz	3115	6431	2019-01-23	2021-01-23	Requires Calibration
E1356	Hewlett Packard	Pre-Amplifier	Pre-Amplifier 1-26.5GHz	8449B	3008A01353	2018-09-10	2020-09-10	Requires Calibration
E1123	IXIA Technologies	Traffic Generator & Performance Analyzer		WaveTest 20	WT20-X1120005	2012-10-11	2015-10-11	Calibration Not Required
E907	Rohde & Schwarz	Test Receiver	EMI (20Hz to 40 GHz)-150 +30dBM	ESIB40	100101	2018-04-17	2020-04-17	Requires Calibration

8 TEST FACILITIES

All measurement facilities used to collect the measurement data under normal condition are located at 600-700 Mountain Avenue, Murray Hill, New Jersey 07974-0636 USA. The field strength measurements of radiated spurious emissions are made in a FCC and IC registered semi-anechoic chamber AR9 (FCC Site Registration Number: 896745, IC Filing Numbers: 6933F-9). The sites were constructed and are continuously in conformance with the requirements of ANSI C63.4 and CISPR Publication 32.

Nokia Global Product Compliance Laboratory is accredited with the US Department of Commerce National Institute of Standards and Technology's National Voluntary Laboratory Accreditation Program (NVLAP) for satisfactory compliance with criteria established in Title 15, Part 7 Code of Federal Regulations for offering test services for selected test methods in Electromagnetic Compatibility; Voluntary Control Council for Interference (VCCI), Japan; Australian Communications and Media Authority (ACMA). The laboratory is ISO 9001:2008 Certified.

United States Department of Commerce
National Institute of Standards and Technology

NVLAP®

Certificate of Accreditation to ISO/IEC 17025:2005

NVLAP LAB CODE: 100275-0

Nokia, Global Product Compliance Lab
Murray Hill, NJ

is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:

Electromagnetic Compatibility & Telecommunications

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).

2018-09-05 through 2019-09-30
Effective Dates

DEPARTMENT OF COMMERCE · UNITED STATES OF AMERICA

For the National Voluntary Laboratory Accreditation Program

9 REFERENCES

[1]. Title 47 Code of Federal Regulations (CFR) Parts 2 and 15.

[2]. FCC KDB 905462 D02, Compliance Measurement Procedures for Unlicensed-National Information Infrastructure Devices Operating in the 5250-5350 Mhz and 5470-5725 MHz Bands Incorporating Dynamic Frequency Selection, April 8, 2016, v02.